HUGHES AIRCRAFT COMPANY
ORDNANCE DIVISION

1841
XLV

1/-

FLIGHT AND THE AIRCRAFT ENGINEER FILES

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

APRIL 6th, 1944

Too many aboard his rescue plane

After picking up eight members of an American air crew, Acting Flight Lieutenant Stanley Trevallion found that, because of the overload, he was unable to take off.

He taxied for an hour in a rough sea until able to transfer the rescued men to a high-speed launch.

On another occasion, while piloting a Walrus aircraft, he rescued a number of airmen and brought them back safely to base despite the overload.

From the EVENING STANDARD, January 7

The development and construction of the R.A.F. High Speed Rescue Launches is another of the achievements of

THE BRITISH POWER BOAT COMPANY LTD.

Constructors of Scott-Paine designed Surface Craft

THE BRISTOL AEROPLANE COMPANY LTD.

FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

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The Outlook

Keeping It Up

BOMBER Command's surprise attack on Essen on the night of March 26th-27th was, in its way, a compliment to the German power of recuperation. The so-called Battle of the Ruhr was fought between March 5th and July 25th last year, and during that time some ten million square feet of floor space in Krupps' works were damaged. Since then about one-fifth of that space has been repaired. It was obviously time for another attack.

The War Department in Washington has also paid testimony to what it calls, in non-basic English, "the recuperative capacity of the German aircraft industry." The statement which the War Department has issued explains the bombing policy of the U.S. Army. That policy is well understood in the British Isles, but it may not be so clearly comprehended on the other side of the Atlantic, where the realities of the war are more remote from the daily life of private citizens. It also gives some facts which will be instructive to people on this side.

The American statement says that Germany had planned to treble her production of single-engined fighters during 1943, and by July 1st had actually succeeded in increasing her fighter production by 50 per cent. An official British estimate gave the increase as 1,000 first-line fighters. However, in July, the statement goes on, the R.A.F. and A.A.F. switched their attention from the U-boat industry to aircraft factories, and by September 1st had cut the production of single-engined fighters to about three-quarters of the July level. It is also estimated that in 1943 bomber attacks had prevented the production of 2,500 fighters. The final conclusion is that by March 1st, 1944, the enemy's monthly production of single-engined fighters had been cut by two-thirds, twin-engined fighters by slightly more, and bomber production by one-third. This reduction is not regarded as permanent, and the bomber offensive must therefore be kept up.

It has been admitted over here that the daylight precision bombing by the Americans has been the chief factor in the damaging of German aircraft factories, and, therefore, it is satisfactory to note that the enemy's single-engined fighters have suffered most severely, for it is they which constitute the greatest menace to the day bombers. But all this is only a means to an end. The Washington War Department has restated its intention of destroying the German fighter force either in the air or on the ground. If this object is materially achieved, the German bombers which try to meet the Allied invasion force will have no fighter cover, and should fall easy victims to the great force of fighters which Air Chief Marshal Sir Trafford Leigh-Mallory has under his command.

Imperial Defence

LORD CHATFIELD'S suggestion that a national, or preferably imperial, council of defence should be set up after the war has many attractive features. It may or may not be the best plan for achieving the object which the gallant Admiral of the Fleet had in mind, but at least it sets people thinking on the right lines.

In the inter-war years it was the function of the Committee of Imperial Defence to lay before the Government of the day skilled strategic advice, but the C.I.D. could not always make sufficient impression on a Government. It was too purely a Service and technical body, and so its views were liable to be brushed aside by politicians who found them inconvenient. Lord Chatfield would have a strong, in fact a majority, element of

politicians from all parties, and preferably including the Dominions, on his council, and therefore its views could not be lightly disregarded.

We all have to face the possibility that a pacifist Government may be in power at some time in the future, and we all want to guard against the danger of its once more cutting down the fighting Services below the danger level.

It is likewise most necessary to see that the Army (however small it may be) has an adequate Tactical Air Force at its disposal, not a mere handful of tactical reconnaissance squadrons camouflaged under the imposing but misleading title of army co-operation squadrons. The Air Defence of Great Britain Command ought always to be adequate to deal with a surprise attack on the British Isles. The peacetime composition of Coastal Command should be a matter of careful consideration, because on it and on the Royal Navy depend the nation's ability to withstand attempts at blockade. Airborne troops may perhaps be found the best means of guarding against attempts to arm in secret by possible aggressor nations.

In the inter-war years few politicians cared for any of these things. They told the experts to discuss them, and disregarded the findings of the experts. Lord Chatfield's scheme would at least rule out the possibility of any political party assuming the role of Gallio.

130 Million Horse-power

MOTORISTS who grumble because of their small petrol allowances may find some comfort in the announcement that the 100,000th Rolls-Royce Merlin aircraft engine has just been produced

The Merlin started, when it first went into production in 1937, at 1,000 b.h.p. for take-off. The power of the latest type of which details have been published is over 1,650. Thus in seven years the output from this amazing engine has been nearly doubled, without increasing its capacity or its frontal area.

Although a rather academic speculation, since obviously it could not occur in practice, it is interesting nevertheless to reflect that if all those 100,000 Merlins were run at the same time, and if we assume that their average power was 1,300 b.h.p., they would develop 130 million horse-power and consume, at half a pint per horse-power per hour, 8 million gallons of fuel in one hour!

It is not, of course, claimed that all these Merlins were produced in the Rolls-Royce parent factory. They are the result of hard work by hundreds of thousands of people in the Rolls-Royce main factories and the works of their numerous sub-contractors, as well as by the American Packard Company.

The Merlin is very far from being "finished" yet, and in the Griffon it has a successor which may well be destined for just as great development.

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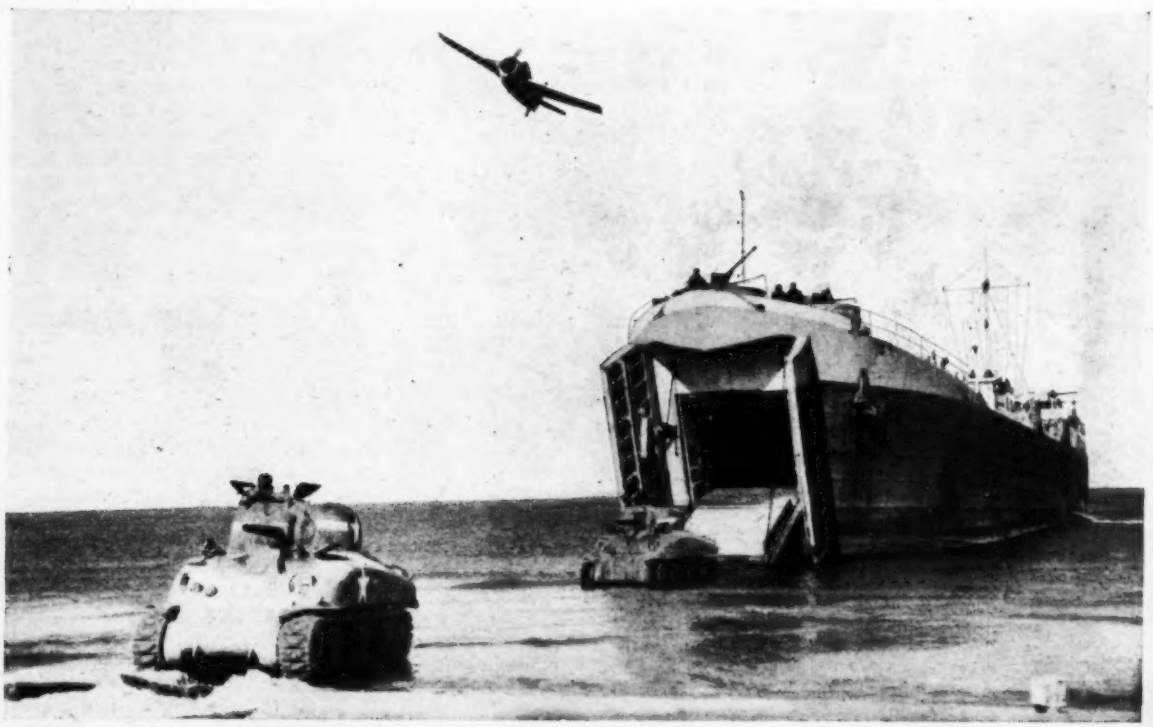
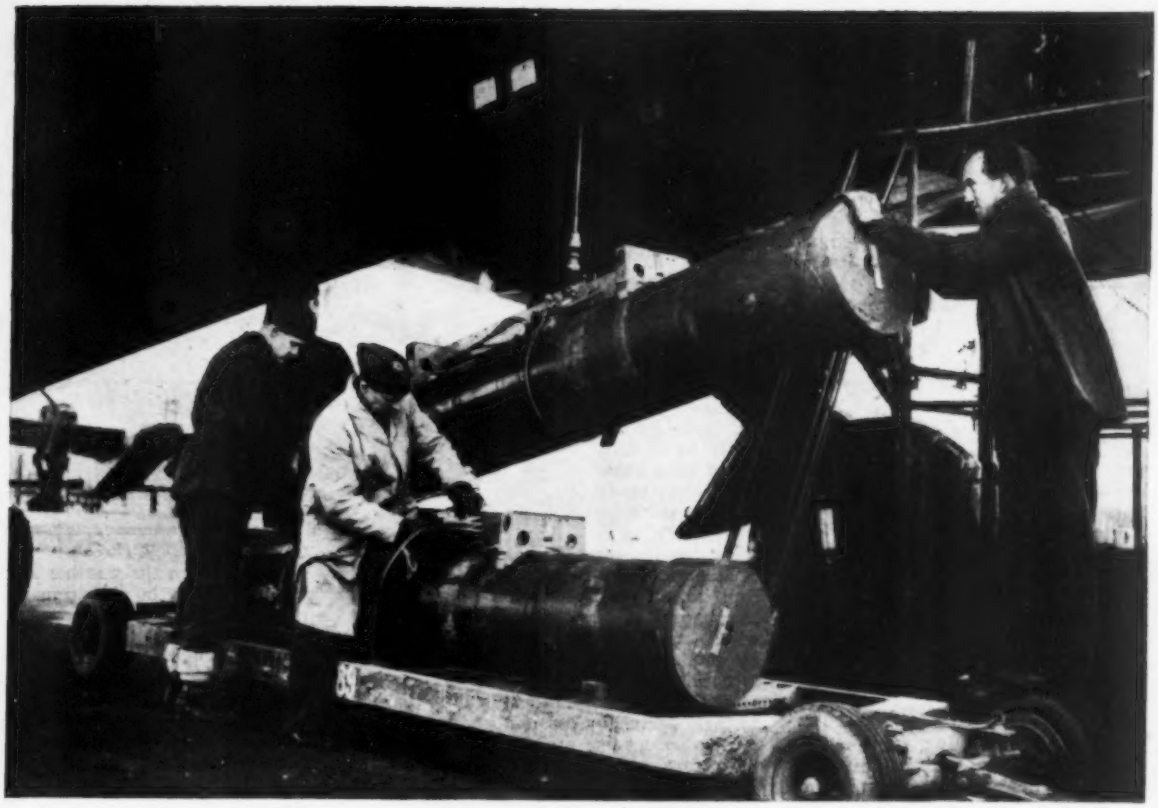


INVASION MOTIF: A photograph which typifies the co-operation of the three services in amphibious warfare. The Navy transports the Army and covers the landing with its guns, while the air forces put an umbrella over the whole operation.



"MINES WERE LAID . . ." : Filling the capacious bomb bay of a Short Stirling with sea mines.

WAR in the AIR

The Pas de Calais Objectives : Elijah's Ravens at Cassino : Air Superiority in Burma

DAY after day the medium bombers of the R.A.F. and the U.S. 9th Air Force cross the Channel to attack the unspecified "military targets" in the Pas de Calais. Whatever these may be, the attacks seem to have kept them quiet hitherto. In addition, mediums, and sometimes Fortresses and Liberators as well, take an easy day by attacking airfields in France. Locomotives seem to have lost the great attraction which they not long ago had for fighters and fighter-bombers, and airfields and training stations further inland are now preferred.

The futility of bombing airfields is always a matter for discussion. When it is done tactically during a battle to prevent the enemy aircraft from harassing our own troops it is often very useful, but the effect is usually only temporary. In these raids the object probably is to provoke the enemy fighters to come up and engage in combat, and this they often refuse to do. In that case the buildings are damaged or destroyed, and a certain number of aircraft are destroyed at their dispersal points on the ground. It is said that the frequent recurrence of these raids has driven the Germans back from the airfields nearest to the shores of the Channel to others farther inland. Those advanced bases were doubtless very useful during the period when the Fw 190s were indulging in daily tip-and-run raids on the towns along the South Coast of Britain; but the Typhoons defeated those raids some time ago and made them not worth while. Otherwise their evacuation, if it is a fact that they mostly have been evacuated, will not matter very much to the Germans.

The bombing of the airfields has not

VICTORY IN THE AIR : An Me 110 falls to the guns of a U.S. 8th A.A.F fighter.

WAR IN THE AIR

prevented the enemy from sending forces of 100 bombers at a time to attack London and other parts by night. That more machines have not been sent is probably due to the prevailing policy of conservation rather than to losses inflicted by our own raids on the airfields. The weather also has doubtless had a good deal to do with the choice of nights for an attack on England. The Germans do not care to come over on clear nights, especially if there is a moon, for such conditions favour our night-fighters. It is also possible that the Germans have learnt a lesson, and now realise that night raiding makes no difference to British war effort. A comparatively small raid can be represented to their own people as a heavy one and as a reprisal for the damage done to Berlin and other German cities. But the proportion of losses suffered by the German raiders has not been light. In the aggregate the losses have not been considerable, but they must have a discouraging effect upon the small number of aircrews sent out on each raid.

Hill Tops in Italy

THE position in Italy gives the Allies no grounds for satisfaction. The destruction of Cassino by bombing has brought them no nearer to capturing the place, and one cannot help questioning why aircraft were called upon to do this job, when ample artillery was available. In any case, the Germans have proved themselves fully as capable of holding our men at bay from improvised positions in the ruins as they were when the buildings of the town were standing upright. The destruction of the monastery has also failed to bring about the capture of the town, and we do not know whether it even saved the lives of any of our men.

Parties of New Zealanders and Gurkhas had established themselves on various high points round about, and for some time they have had to be supplied by air. Correspondents have marvelled how these parties got up to such positions, where not even jeeps, mules, or even porters could reach them with supplies. No feat seems to be beyond the capacities of New Zealanders, while all Gurkhas are essentially mountaineers, and very fine mountaineers, too.

AIRGUNS : The N.A-B.25 Mitchell, showing the 75mm. cannon in the lower part of the nose. The two machine guns on the centre line are 0.5in. calibre and the bulge on the top starboard side is made by the recording camera.

The early attempts to drop supplies to these parties by parachute were not always successful, and it must have been terribly disappointing to men who were hungry and thirsty, as well as short of ammunition, to watch the parachutes with their badly needed supplies in the canisters floating down out of their reach, and probably falling a good distance down the mountain side. The pilots persevered, and soon became more expert in dropping the parachutes and canisters on the peaks occupied by the troops; but at the best it must have been a chancy business, and the men must have had a very uncomfortable time. One is glad to know that they have been withdrawn, though the descent from their eyries (doubtless made by night) would inevitably have been a hazardous affair, probably not much less dangerous than their original ascent.

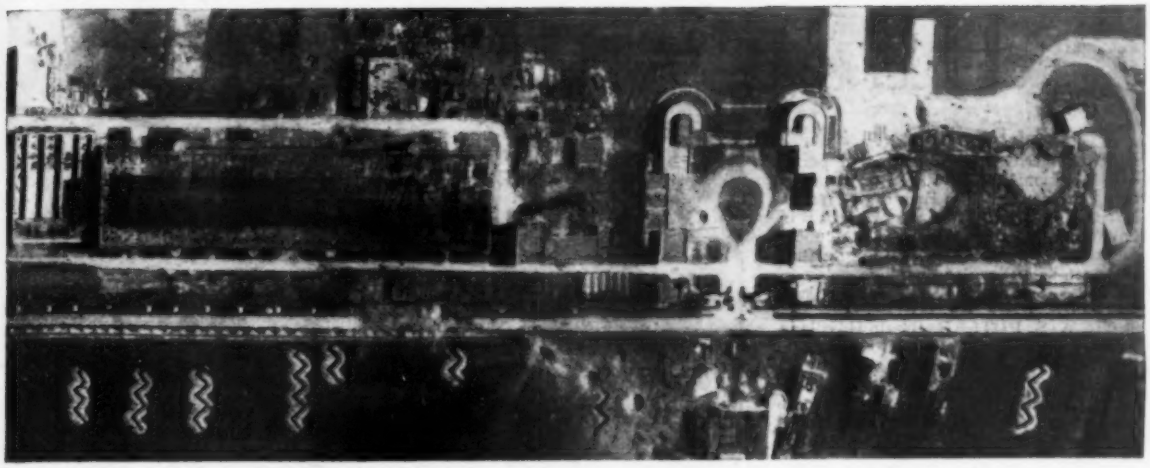
In the meantime there is a stalemate at Cassino, but when the weather improves the Allies may be able to make an advance. In any case, progress seems to depend on the infantry, with artillery support, and too much must not be expected from our superiority in the air. Aircraft in a land struggle are a specialised arm, extremely potent on the right occasion, but by no means maids of all work.

The Activity in Burma

THE news from Burma gives small opportunity for an observer at a distance to attempt a summary. There the Fourteenth Army holds undoubted air superiority, but we have no means of judging what that superiority is exactly worth. The Japanese are moving towards our base at Imphal, the capital of Manipur State, from several directions, and at one point at least have met with some success.

The enemy had assembled a not inconsiderable force of aircraft to back his advance, but before the end of March the British and American fighters had destroyed 133 enemy machines for a loss of only 33. One

AIR/SEA BATTLE : A mid-Atlantic scene as two Wildcat fighters from the escort carrier H.M.S. *Biter* shoot down a Junkers 290. The dark cloud on the horizon is where the Ju 290 hit the water in flames.



STARVING THE LUFTWAFFE : The S.N.C.A. Du Sud Ouest aircraft factory at Chateauroux-Deols, France, after a visit by our heavies on the 10th of March. The factory had been producing the Siebel 204 which is described on pages 369 and 370.

WAR IN THE AIR

would have thought that the constant air attacks on Japanese communications in a country like Burma, where there are few railways and roads, and most traffic must go by river, would have embarrassed the enemy. Probably they did; but he doubtless moved his river craft by night, and so got enough stuff up to the front to make his offensive possible.

The rapid succession of brilliant Russian victories almost makes the head swim. With the Red Army at the foot of the Carpathian mountains one wonders how long the Germans will be able to keep Rumania fighting on their side. Lvov (which was known during the last world war as Lemberg) is also threatened, and Russian bombers are now boldly launching forth and attacking all routes which lead to that city. It may be that before long the Russians will get within bombing range of Ploesti, and in due course occupy that very important oilfield; but the Carpathians are a rather formidable barrier. In the meantime one continues to wonder why the Mediterranean Air Force or the Middle East has not paid another visit to Ploesti.

Far away in the West the R.A.F. and Americans have kept up their almost ceaseless attacks. On March 29th Fortresses with a medium-sized escort of fighters bombed Brunswick, and on that occasion they forced the *Luftwaffe* to fight. The escort shot down 39 German fighters, drove off the rest, and also destroyed a number of enemy machines on the ground.

At the same time Liberators were making a daylight raid on those intriguing targets in the Pas de Calais, and they were not molested at all by fighters. It is evidently the official policy not to publish the results of these Pas de Calais raids, but, as was remarked above, the Germans have not yet fulfilled their repeated threats to use new and secret weapons against Britain. They may, of course, do so at any moment, but it does not seem over-optimistic to conclude that the daily attacks on the Pas de Calais, now by mediums, now by heavies, have had a restraining effect. The mediums are probably making the better shooting, but a volley from the heavies every now and again will probably help in the good work.

Gen. H. H. Arnold, who commands the whole Army Air Forces of the United States, has explained to an American audience the policy of forcing the *Luftwaffe* to fight in defence of its production centres. "Here," said the General, "is the crux of our air strategy, and here we have been able to face the enemy squarely with a desperate dilemma. The only way he can fight back against these air attacks is by putting up strong forces of fighter aeroplanes. He has no fighter aeroplanes to spare. He knows that when we come ashore in the West he is going to need those aeroplanes desperately."

The General explained the difference between Allied early raids, when the only practicable technique was quick—really sneak—blows with the hope of a few lucky hits. We do not, he said, do it that way any more. Now we engaged in planned battles, trying to take the enemy by surprise, to feint him out of position, and if possible make him uncover the point where we mean to slug him.

Gen. Arnold described the present air attacks as by no means preliminaries to invasion, but as actual invasion. This was hardly a correct use of words. Invasion implies occupation, and that is a thing which bombers are not able to accomplish. The bombing offensive is rather comparable to the naval blockade.

MORE ATMOSPHERICS? : Flak-damage to the radio compartment of a Fortress sustained during a raid on Berlin.

HERE AND THERE

Jet Development

ACCORDING to daily Press reports, development of the jet plane is being transferred from Britain to Canada. Mr. C. D. Howe, Munitions Minister in Canada, is credited with this announcement, but we cannot help thinking that he must have been sadly misreported.

Help from de Havilland

MR. A. S. BUTLER, the de Havilland chairman, has offered to the Herts Education Committee a 90-acre site at Hatfield for the building of a technical college. He has also promised help towards an extension if the college will provide instruction in aeronautical engineering.

T. P. Wright at Buckingham Palace

AFTER a visit to this country lasting several weeks, Mr. Theodore P. Wright, Director of the American Resources Control Office, has returned to America. During his stay Mr. Wright visited a number of aircraft factories and testing establishments.

Shortly before his departure he was received in audience by His Majesty the King, an honour which has given as great pleasure in this country as it will have given his compatriots. Ted Wright has ever been a very good friend of England and has done a great deal for us in one way and another.

Fine Performance

AN Avro York of R.A.F. Transport Command has brought New Delhi within two days of Great Britain by completing the 6,857-mile flight in 42 hr. 30 min. Its captain was Flt. Lt. E. Wright, D.F.C. Carrying 8,000 lb. of urgent stores for South-east Asia Command, the York followed the regular trunk route via Cairo and Karachi and encountered adverse weather and a 25 m.p.h. head wind during the early stages. But it was never "pushed," and mostly cruised at just over 214 m.p.h.

Stops *en route* absorbed just over 10½ hr., the actual flying time being 31 hr. 54 min., giving an average speed of 201.6 m.p.h.

OVER TO YOU, OVER ! More than 100,000 miles of overseas air routes are now spanned by R.A.F. Air Transport Command, which has grown enormously in the past year. This is a glimpse of the control tower at the European Wing.

Not Very Tactful

IN the course of a recent broadcast on the German radio, the Nazi speaker is reported by Reuter to have said: "Victory will not fall on us from the skies."

One cannot help feeling that victory must be the very last thing his German listeners would associate with what actually does keep falling on them out of the skies!

Ford's Glider Contract

A $17,000,000 contract to build CG-13 Waco gliders for the U.S.A.A.F. has been announced by the Ford Motor Co. at Detroit.

The CG-13 is a larger development of the CG-4A troop-carrying and transport glider in service in great numbers in Britain and overseas with both the U.S.A.A.F. and the R.A.F., to whom it is known as the Hadrian.

With a welded steel tube, fabric-covered fuselage, and wooden wings with stressed skin plywood covering, the CG-13 can take thirty fully equipped troops, or two jeeps, or a howitzer and a jeep with their crew and ammunition.

Compulsorily Amphibious

THE occasions on which a flying boat has been safely put down on dry land are probably few, but there was a recent example of this delicate manœuvre being successfully applied to a Sunderland.

The pilot was F/O. G. O. Singleton, R.A.A.F., who, having alighted in a rough sea to rescue some ditched comrades from their dinghies, decided to try a take-off when an attempt at towing by a destroyer had failed.

Singleton managed to get his Sunderland airborne, but a big wave smashed a 7ft. hole in its hull just as it came "unstuck," and he was obliged to land on an airfield near his base.—Nice work, Aussie !

These "Post-war" Guesses

PROBABLY the biggest unknown factor about post-war civil aviation is the amount of public patronage it will receive, and the estimates given from time to time by "experts" vary over a wide range.

Our contemporary *American Aviation*, of February 15th, quoted Mr. Grover Loening, aircraft consultant to the U.S. War Production Board, as saying that by 1950 trans-Atlantic air travel will be well over twenty times as large as figures which have been based solely on previous steamship traffic. Saying that it was a great mistake to base such esti-

1945?

CAIRO TO THE CAPE: The first Spitfire to fly from Cairo to the Cape snapped from its Ventura escort just after taking off. Borrowed for exhibition by the South African Government, it was flown by F/O. G. E. Camplin, of Transport Command.

HERE AND THERE

mates on shipping figures, Mr. Loening remarked: "We might just as well have figured the automobile industry's capacity, in 1910, by the number of people who were riding around in horse and buggy."

Reckoning a trans-Atlantic crossing to take 15 hr., Mr. Loening says post-war air traffic over this route should be gauged by the number of people on all the railways and buses in the States who take trips to places 15 hr. away.

Maybe he's got something there!

Ironical Fate

A MESSAGE from Melbourne tells of the death of F/O. L. G. Fuller, R.A.A.F., who won the D.F.M. at Palermo. But he first became known in 1940 when, piloting a trainer, he pulled off an extraordinary "pick-a-back" landing with another aircraft on top of his own after a mid-air collision.

Ironically enough, Fuller met his death in a cycling accident.

"Why don't they use parrots and save paper?"

We Hope They're Right

PILOTS and aircrew of the R.A.A.F. who recently arrived at Brisbane on leave from operational duties in Great Britain expressed the opinion, in interviews with the Press there, that Germany's end was not far distant.

The whole of Germany would become a scrapheap, they are reported as saying, unless the Germans cried "Enough" before it was too late.

His Journey Was Necessary

MR. D. McVEY, director-general of civil aviation in Australia, arrived in England by air recently in order to attend the Commonwealth communications meeting in London this month.

Last year Mr. McVey led the Australian air mission to America and Britain.

South African Attitude

MR. F.C. STURROCK, South African Minister for Transport, said that the Union Government intends to retain sovereignty over its own air space. He made the statement when he explained the main principles of the Union Government's post-war aviation policy.

He also announced that it is proposed to build three airports—one in the neighbourhood of Johannesburg, which will be an international airport, and others at Durban and Cape Town, which will be national airports. The three airfields will be constructed by the South African Railway.

Portuguese Protest

THE new company formed by the chief Portuguese shipping lines and the *Aero Portuguesa Limitada* to exploit air communications with their colonies and Brazil after the war, mentioned in these columns last week, is causing something of a stir in Lisbon, according to a Reuter correspondent there.

The feeling is growing, it seems, that this new combine should not be allowed to become a monopoly, and this point, first ventilated in the *Jornal do Comercio*, has now been taken up with considerable vigour by the influential newspaper, *Seculo*.

U.S. Call for Women Pilots

ADDRESSING the U.S. House of Representatives on the man-power problem recently, Gen. H. H. Arnold, commanding the U.S.A.A.F., said he hoped they would get enough women pilots to replace every man now serving in America.

Women pilots, he said, could be used for ferrying, target towing, and similar non-operational flying jobs. Already there were 534 women pilots in the "Wasps" doing air transport work, and it was not unreasonable to hope that eventually all such work would be done by women pilots.

There was no intention, he added, to send the "Wasps" into combat overseas.

Well Caught, Sir

THE latest (we nearly wrote "tallest") story from the South-west Pacific tells how a Boston pilot "captured" the log-book of a Jap ship attacked off Wewak.

After the initial attack at masthead height, a second formation of Bostons swept down on the Jap and arrived just as a violent explosion occurred immediately forward of the ship's bridge. Debris sailed 75ft. into the air, and, when one of the Bostons was being examined later at its base, the ship's log-book was found inside the cowling of one of its engines, nestling behind a cylinder!

This established that the ship was the *Taimei Maru*, of 3,000 tons, and certified as "fit to carry dry and perishable cargoes."

We understand, however, that there is no truth in the rumour that this incident has given rise to a new A.M.O. requiring log-books to be produced as proof of successful sorties against shipping in future.

TURBINE-COMPRESSOR UNITS

PROBLEMS OF SMALL-SIZED UNITS : FUEL CONSUMPTION FACTORS : HEAT EXCHANGERS

By G. GEOFFREY SMITH, M.B.E.

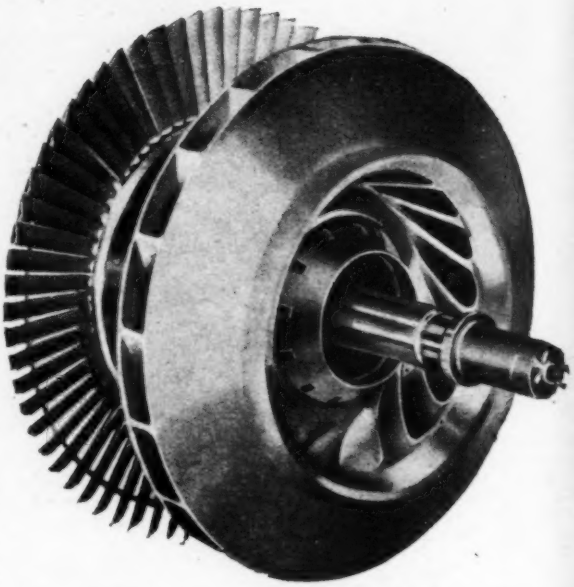
FROM a study of jet-propulsion projects now undergoing development in various countries and particularly those of Swedish and Swiss engineers, multi-stage compressors and turbines easily outnumber other alternatives. When very high powers—say, 5,000 h.p.—are under contemplation it would appear inevitable that the simple centrifugal or rotary displacement type components must give place to axial-flow or multi-stage designs. At the moment it is probable that most of the projects covered by patents are miniature replicas, with desirable modifications, of very large plants of proved success, and these smaller units have not yet been developed to a practical stage. There are fewer problems in producing a successful combustion gas turbine-compressor unit of, say, 2,000 h.p. than a small unit of, say, 400 h.p.-500 h.p., which is roughly the minimum practicable size at this stage of progress.

In a turbine the pressure drop generating kinetic energy for conversion into mechanical work takes place partly in the fixed blades and partly in the moving blades. A "stage" is defined as any portion of the turbine in which a drop of pressure occurs for the generation of kinetic energy. Thus the blade scheme is a fundamental step in turbine design and naturally involves the determination of the number of stages to be adopted to suit the range between combustion and exhaust conditions. The continuous fall of pressure in a multi-stage reaction turbine requires a high-velocity ratio to ensure the best stage efficiency, and the efficient utilisation of the heat drop for a given range of pressure and exhaust conditions. Since all the rings of blades are fixed on the rotating central shaft and run between rows of fixed blades in a casing enclosing the whole mechanism, the possibility is ever present of gas leaking past the tips of the rotating blades without giving up energy. The design of a turbine blade involves more cerebration than any other engineering component.

Component Efficiencies

Whilst the future holds the greatest promise for multi-stage turbines, similarly to the compounding of steam engines and steam turbines, a single-wheel turbine can be employed with success. This may have fixed guide vanes or a fixed ring of nozzles to direct the gas stream to the blades or buckets on the periphery of the wheel.

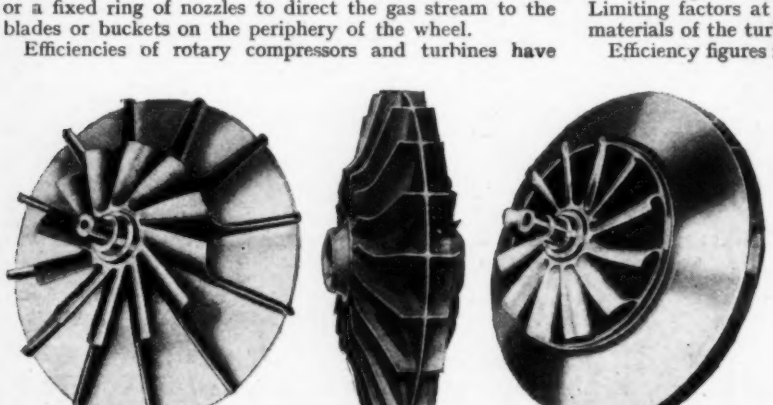
Efficiencies of rotary compressors and turbines have been increased considerably in the last few years. The work of compression (the negative work of the thermal cycle) constitutes a large proportion of the work done in expansion (the positive work of the cycle). As much as 75 per cent. of the power developed by the turbine may be internally absorbed in driving the compressor. That is, a 2,000 h.p. unit may finally deliver but 500 thrust horse-power. It will be readily appreciated, therefore, that the ratio of positive/negative work is of the greatest importance in a turbine-compressor unit, just as the thrust/drag ratio determines the efficiency of an aircraft. Limiting factors at present are the temperatures that the materials of the turbine can withstand.



The combined rotor of a radial compressor-axial turbine unit. Actually it is an example of a Buchi exhaust turbo-supercharger.

Efficiency figures for turbines and compressors have been quoted before learned societies on different occasions. Adolf Meyer, when lecturing to members of the Institution of Mechanical Engineers, showed that an increase in the overall efficiency of compressor and turbine from 70 to 75 per cent. raises the cycle efficiency from 15 to 18 per cent., representing an improvement of 20 per cent. Every 1 per cent. increase in the efficiency of the compressor meant, therefore, an improvement of 4 per cent. in the cycle efficiency. That was in 1939 and it may be assumed that considerable progress, resulting from concentrated study of the problem, has been achieved in the interim.

He also showed the benefit



Three different centrifugal compressor impellers. From left to right : single-entry web, double-entry web and shrouded types are shown. All have curved entry vanes.

employing of higher temperatures. With an overall compressor and turbine efficiency of 76 per cent., increasing the temperature at the turbine inlet from 1,000 to 1,200 deg. F., raises the cycle efficiency from 18 to 23 per cent., representing an improvement of 28 per cent.

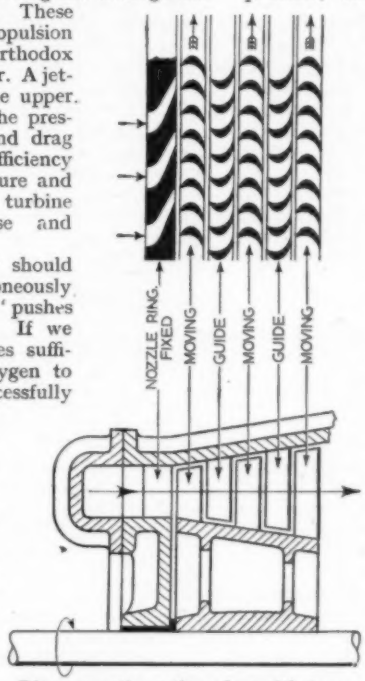
High temperatures such as those quoted are admissible only when materials of a correspondingly high creep strength are made available, or when some means are devised for protecting the blading of the materials now used against the effects of such high temperatures.

Jets Do Not Push

At high altitudes and low temperatures the positive/negative work ratio will be substantially larger for a given temperature at the turbine, whilst ram compression due to high speed has the effect of further improving the average efficiency of the compression system. These facts explain in part why the jet propulsion plant excels in air strata where orthodox piston engines appreciably lose power. A jet-propelled aircraft gains speed in the upper strata by reason of the fact that the pressure of the atmosphere is lower and drag is reduced, while the propulsive efficiency of the jet is enhanced as the pressure and temperature drop through the turbine is increased in the less dense and colder air.

This explanation incidentally should finally answer those who still erroneously contend that the jet "presses" or "pushes on the air" to effect propulsion. If we could carry in containers or bottles sufficient compressed air to supply oxygen to burn fuel, jet propulsion would successfully operate in the rarified air of the upper stratosphere just as in the case of rockets. Indeed, jet-propelled aircraft can attain speeds and heights far beyond the present limits imposed by the normal power plant.

These were some of the influences which Group Capt. F. Whittle first appreciated years ago, coupled with his refusal to believe that the efficiencies of blowers and turbines as well as the properties of materials could not be improved over the years to the point where the gas turbine became practicable. An enormous concentration of effort is required to bring schemes of this kind to practical success. Edison is credited with the dictum that invention was 5 per cent. inspiration and 95 per cent. perspiration. That process of patient study and experiment was the prelude to Whittle's successful development of a relatively small gas turbine, which ran on the test bed in 1937, though turbines in large sizes are by no means new.



Diagrammatic section of a multi-stage axial turbine and a plane development of the blading system.

Possibilities of Gas Turbines

It may be well to stress again that this new engineering development should not be considered solely as a jet-propulsion unit. Rather jet propulsion should be thought of as a special application of the gas turbine. Component efficiencies will continue to rise with prolonged development and research. Utilising the gas turbine as a means of producing mechanical power at the shaft, and possibly with slower running turbines to simplify the reduction gearing, new and greater possibilities will be foreseen. In passing it may be recalled that Parson as long ago as 1910 produced a steam turbine running at 2,000 r.p.m. which by the aid of reduction gearing drove a three-high steel rolling mill at a speed of only 70 r.p.m.

At present, in comparison with the highly developed reciprocating engine, the fuel consumption of gas turbines is high, particularly if the comparison is made in terms of gallons per thrust horse-power hour. On the other hand, for interceptor fighter aircraft, the ability to reach operational height and to engage the enemy as quickly as possible is the more important consideration while the war lasts. Nor is the fuel consumption problem insuperable in the passage of time.

In due course, now that British and American engineers are concentrating on the problem, the evolution of special alloys able to withstand a combination of high stresses and high temperatures will prove a most important factor in development. Already the pioneer work of home metallurgists has contributed in no small measure to the prospects of gas turbines for more general uses, and the larger the size of unit adopted the greater the measure of success.

Whereas the reciprocating engine is limited in its possible variations, since the three major operations of compression, combustion and expansion take place in one organ—the cylinder—in the gas turbine specialised organs are used for each of these processes. Thus a wide variety of arrangement is possible both for the turbine and the compressor, which may be of the axial flow, centrifugal or rotary displacement type.

Future development will be favourably affected by the progress with heat exchangers, ducted fans and propellers.

Benefit of Heat Exchangers

A marked improvement in the cycle is obtained by utilising the heat of the exhaust gases of the turbine to preheat the compressed air at a point between the compressor and the combustion chamber. Such heat exchangers, as they are termed, conduct a portion of the exhaust gases along the piping between the compressor and turbine. On the size of this preheater and its precise location a great deal depends. For example, considering a turbine with an inlet temperature of 1,000 deg. F., by recuperating heat from the exhaust gases in a heat exchanger of suitable surface area, the efficiency of the cycle may be improved as much as 25 per cent.

The range of possible variations in design features provides immense scope for designers and development engineers, so that gradually in the process of evolution, overall efficiency, and correspondingly fuel consumption, will be improved far beyond present attainments.

In the case of large, long-range passenger-carrying air-liners, fuel consumption (apart from cost) naturally assumes paramount importance. It has been calculated that for a transatlantic aircraft of an all-up weight of 280,000 lb. and normal-type engines of 28,000 h.p., weighing 56,000 lb. (20 per cent.), the fuel would weigh 107,500 lb. (38.5 per cent.), structure 92,500 lb. (33 per cent.), and the fifty passengers with baggage, mail, eight crew, equipment 24,000 lb. (8.5 per cent.). Dr. H. Roxbee Cox, who gave these data in his Wilbur Wright Memorial lecture before the Royal Aeronautical Society in 1940, had in mind a large passenger-carrying aircraft of approximate cruising speed of 300 m.p.h., range 5,000 miles and a take-off of 1,000 yards.

At the present stage of development, such a long, non-stop range is not within the capacity of turbine compressor units, but it must be remembered in any study of the figures quoted that the weight of turbine power units would be approximately only half the estimated figure of 56,000 lb. quoted for reciprocating engines; that is, commercial-type engines which are heavier than specialised military versions. If a net saving of as much as 28,000 lb. could be achieved, it would permit of (a) considerably reduced structure weight and/or (b) a heavier fuel load. These are only some of the immense possibilities opened up by the new era of power generation by gas turbines.

Jets versus Airscrews

The Airscrew Can Hold its Own Up to 5,000 h.p., 40,000ft. and 500 m.p.h.

By L. G. FAIRHURST, A.M.I.Mech.E.

THE article "Jet v. Airscrews" by Mr. Geoffrey Smith in *Flight* of February 17th has aroused a great amount of interest and speculation in connection with jet-propelled aircraft. It may be of value therefore to readers to hear what the airscrew designer feels about it in defence of his heritage.

It might, firstly, be appropriate to say that airscrew designers have followed most intimately the development of jet propulsion for aircraft, and are most mindful of the scientific and practical development which has already been achieved by Group Capt. Whittle and his associates at the Gloster Aircraft Co., Ltd., in introducing an invention which is, without doubt, a new phase in the era of flight.

Nevertheless, it would be most unfair to this body of engineers if extravagant claims at this stage were made which later could not be substantiated, and which would tend to cause widespread disillusionment with the danger that it may even retard the progress of the science of aeronautics and of post-war commercial aviation.

MR. FAIRHURST, who is Chief Engineer of Rotol, Ltd., points out in these notes some of the limitations of jet propulsion and also indicates ways in which the airscrew can help the jet. He treats the subject impartially and his views will be read with interest.

The airscrew designer has for some time been examining conditions of aircraft propulsion under which the airscrew becomes too inefficient to be a useful means of propulsion, and it would appear that with the normal state of development the airscrew will reach the point where top speed propulsion efficiencies of the order of 75 per cent. should be attainable for reciprocating engines of 5,000 h.p. at 35,000 to 40,000ft. in high-speed aircraft around the 500 h.p. mark.

If 15ft. can be taken as the maximum diameter for practical purposes which a single-engine/single-seater fighter could accept, and 22ft. the maximum desirable diameter for heavy bombers or transport, the latter operating at around 300 m.p.h., then the above conditions of power and altitude should be met with the airscrew.

The airscrews will, of course, be of the counter-rotating type with the appropriate number of blades efficiently to absorb the power at the diameters permitted by reasons of aircraft structural design or tip speed.

Altitude Problems

The counter-rotating airscrew development has reached such a stage to date that the "doubling-up" of the maximum number of blades used in a single-hub airscrew should be a most practicable proposition.

To achieve the high-speed efficiency referred to above, some intensive research into blade aerofoil sections and thickness/chord gradings will be essential to delay the compressibility stall; this compressibility stall reducing airscrew efficiency at these high speeds at high altitudes. Accent will also be placed on weight of these airscrews, and here it will no doubt make firm demands for the extensive use of the compressed wooden-bladed type of airscrew which has been so successful during the present war.

It can be said with confidence that for some years hence transoceanic aircraft in service below 30,000ft. will be most economically operated by reciprocating engines and airscrews. If the trend of civil transport should be towards speeds of 400-500 m.p.h. at altitudes around 40,000ft., it will remain speculative as to which form of propulsion would give the most economical operation.

At altitudes and powers beyond those referred to above, and also if the top speed efficiency requires to be increased above the 75 per cent. figure, the airscrew would appear to be at the end of its usefulness for aircraft propulsion, and the jet system most definitely comes to the forefront.

Efficiency and Speed

It is well known that the jet-propelled aircraft in its present form gives maximum efficiency at very high forward speeds and high altitudes. At low speeds jet propulsion has a relatively low efficiency, and take-off and rate of climb are not comparable with airscrew propulsion.

To overcome this deficiency in thrust horse-power, consideration has been given to the use of thrust augmentors which may be in the form of ducted fans or airscrews to increase the amount of air passing through the system.

It is here where the airscrew designer can still retain his heritage, or at least part of it, by providing small-diameter counter-rotating airscrews to absorb a certain proportion of the turbine power, the airscrew being driven from the turbine through a reduction gear to give the appropriate r.p.m. for optimum efficiency.

The additional weight of the reduction gear will, without doubt, be more than offset by the gain in take-off and climb performance, and here again the use of compressed wooden blades for the airscrew will assist in keeping down the airscrew weight to a minimum.

A further claim of the jet-propulsion system is that it permits an aircraft design with an exceptionally low centre of gravity. This, however, should still be possible when using counter-rotating airscrews, since they can provide ample "blade area" for relatively small diameter.

It is also claimed, and quite rightly so, that jet propulsion provides an exceptionally clean aircraft aerodynamically. It must be remembered, however, that in cleaning up the aircraft the problem of diving or landing brakes becomes increasingly difficult, and the airscrew may be found to provide, in addition to the improvement afforded in take-off and climb, some very considerable negative thrust by extending the present flying boat technique or operating airscrews in reverse to provide negative thrust. This additional braking would be invaluable to jet-propelled aircraft as a supplement to the diving brakes or on the heavier class as supplement to the wheel brakes.

It is hoped that from the foregoing brief survey the reader will be able to formulate in his mind some practical idea as to how the airscrew designer views the introduction of "jet-propelled aircraft."

NEW BRITISH FIGHTER

Performance Outclasses All Forerunners

A NEW type of British fighter aircraft having a performance even more sensational than that of any British or American single-seater fighter hitherto produced is now in service with the R.A.F. and is heralded as a super "bomber-killer."

Complete secrecy is being maintained about it—even its name is officially withheld for the time being—but it is permitted to say that it has an enormously powerful, highly supercharged engine which gives it a particularly fine performance at great altitudes.

This new fighter, now in production in readiness for the Second Front in the European theatre of war, represents the accumulated war experience of a British firm of aircraft manufacturers whose name has for years been a household word where fighters are concerned.

Behind the Lines

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Training

THE Aviation and Aircraft Models School of the Ustasi Youth of Banjaluka (Yugoslavia) has now been functioning for two years. The school was reorganised in the beginning of 1944, and it now comprises some 160 pupils.

Precautions

TWO hundred Danish farms have been confiscated by the German military authorities to make place for the construction of three new airfields.

The clandestine paper *Frit Danmark* gives a description of the German defence line constructed in Jutland which is several hundred miles long and runs from Lemvig in the north to Bramminge, near Esbjerg. The line extends to a depth of about 250ft. and consists of a ditch 19ft. wide and 16ft. deep, followed by a 32ft. barbed wire zone, then trenches and a bunker system, and lastly a wide concrete road for troop transports.

Finnish Version

PRESUMABLY to justify the Finnish official attitude to the Russian peace offer, a Helsinki newspaper gives this description of *Luftwaffe* preparations in Finland:

"In the last year the Germans have constructed a number of air bases along the Finnish coast of the Gulf of Bothnia. These bases can have only one function—to send out fighter and bomber aircraft in a westerly direction. The Germans have an air base at Pello, near the Swedish frontier, about ten miles north of Haparanda, and have made a wide motor road to this strategic point from Tervola, between Kemi and Rovaniemi. From Narvik and Pello it would be easy to bomb the Swedish mines and ore transport.

"At Tornio, Oulu, Gamla Karleby, Vasa, Björneborg and Abo there are other German air bases, and German aircraft are also based round Helsinki and at various points inland. It is easy to imagine the effect on the Swedish coastal industry in Norrland, on our railway lines and river bridges, if a blitz air offensive were started from the West Finnish bases now under German command."

Snapshots

"The East is not always in the first place the main theatre of war. To-morrow it may change, and therefore space in the East no longer has the same significance as two years ago.

"The day of invasion will also be the day when the world will see what the German *Wehrmacht* can achieve."—(*A newspaper article.*)

* * *

"Party members who think that it is enough to wear the badge and those who do not wear it for all kinds of reasons will be excluded from the ranks of the genuinely loyal people."—(*From a speech of a provincial Party leader.*)

* * *

"One may still admit ignorance as an excuse for people who say that condensed vapour trails are a means of identifying our own fighters and therefore not dangerous. But it is sheer meanness to invent captured pilots' maps on which certain targets are said to be marked, and to talk foolishly about leaflets which announce imminent attacks. There are unfortunately fools who believe such nonsense."—(*From an Austrian paper.*)

* * *

"It is not possible to evade fighting the storm by shutting the windows in order not to hear it.

"Even to-day there are still reserves available, especially in the sphere of labour supply and in the provision of new plant capacities for armament production which can be mobilised above all in the occupied territories."—(*Reich Minister of Economics Funk.*)

* * *

"The Fuehrer must not be disappointed in his respect for women."

"The Fuehrer himself would prefer women to give voluntary service."—(*From an appeal for women labour in a Cologne daily.*)

Off Norway

ACCORDING to German information in an attack on a German convoy off the coast of Norway, the Russian Air Force has used for the first time torpedoes equipped with parachutes. They were dropped from a height of about 6,600ft.

Dermatitic Fuel

TO the long list of German ersatz a new item was added this month. In certain areas a new anti-knock motor fuel called "*Motorenbenzin Tel*" was distributed to consumers with a warning that its lead content is poisonous and special precautions should be taken to prevent the fuel getting on to the skin.

Preparing

THE A.R.P. authorities of Ploesti publish a list of nine points in the outskirts of Ploesti which will serve as meeting places for the inhabitants of various areas in case of air raids. From these points, leading to various villages in the surrounding areas, prospective air-raid sufferers will be taken, under a military escort, to the respective villages, where they will find provisional accommodation.

From Japan

GENERAL ATSUSHI USHIROGU, Deputy Chief of the Army General Staff, has been appointed to the posts of Inspector-General of Army Aviation and Chief of Army Aviation Headquarters, said the Japanese News Agency quoted by Reuter.

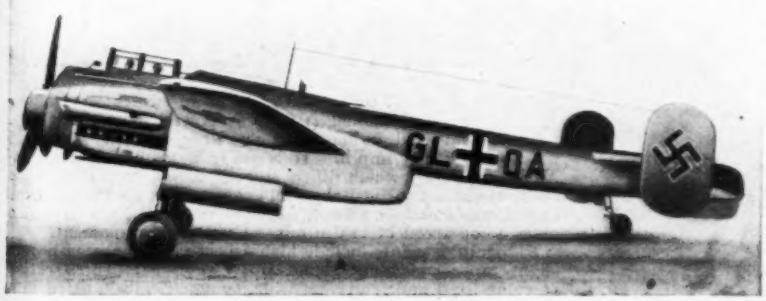
The appointment is welcomed by Japanese military circles as a unification of command over the army air arm similar to that of the navy air arm under Vice-Admiral Tsukahara.

Other appointments announced were: Lt. Gen. Takeo Yasuda, relieved of his post of Inspector-General of Army Aviation and appointed "war councillor"; Lt. Gen. Baron Yoshitoshi Tokugawa, to be principal of the Army Aviation Academy, and Lt. Gen. Asasaburo Kobayashi, to be Chief of Staff of Defence General H.Q.s.

Heinkel He 274?

THE German occupational authorities are reported to have awarded a contract for the construction of the prototype of the Heinkel He 274 four-engined Atlantic transport aircraft, designed by the Ernst Heinkel aircraft company, to an aircraft works situated in the North of France; the machine, which is now under construction, is said to be derived from the Heinkel He 177 heavy bomber and is to be ready to take the air in August, 1944.

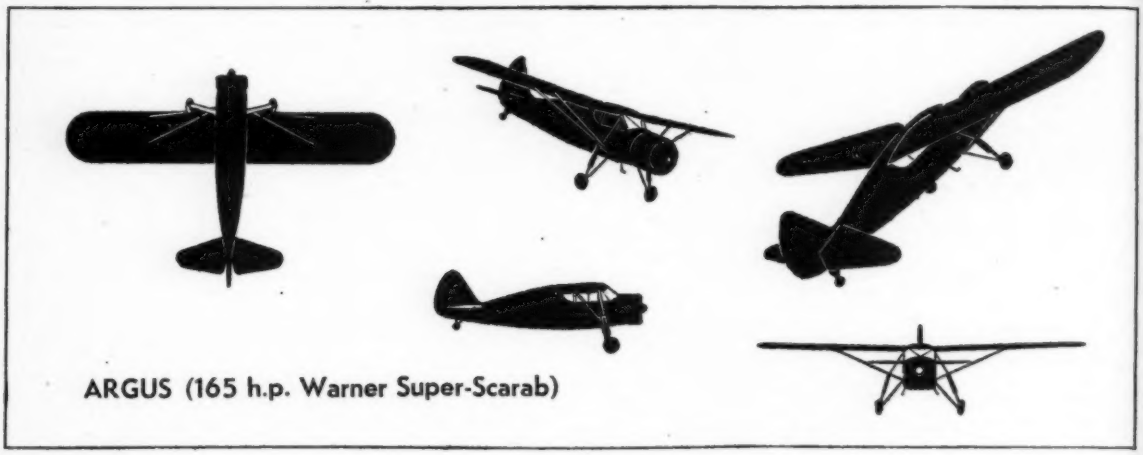
Although it was originally intended to arrange the four 2,000 h.p. BMW 802 eighteen-cylinder twin-row radial engines individually in the wing leading edge, each driving an airscrew, it is now stated that they are to be grouped in pairs, resembling the arrangement of the Heinkel He 177, driving contra-rotating airscrews. The drive is to be effected by means of twin gears developed by the S.N.C.A. du Centre, originally designed for use with the Hispano-Suiza 12Y liquid-cooled engine.



A NEW GERMAN TYPE: The twin-engined Arado Ar 240 is the *Luftwaffe's* reconnaissance fighter-bomber. Note the finning on the the end of the fuselage, the short nose and the long engine nacelles.

Studies in Recognition

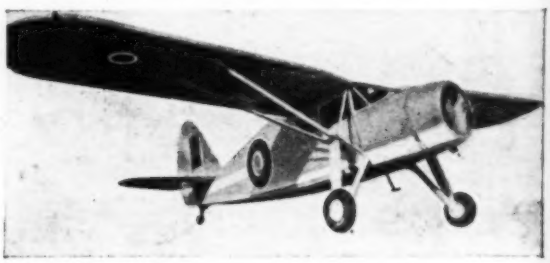
Aircraft in



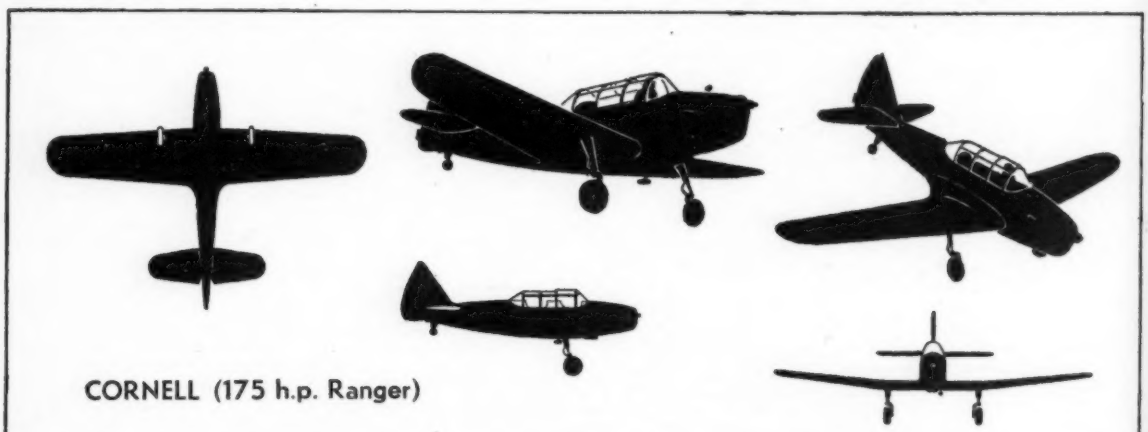
ARGUS (165 h.p. Warner Super-Scarab)

THIS four-seater high-wing cabin monoplane is developed from the Fairchild F-24W civil type and, as the Argus, is used by the R.A.F. and the A.T.A. in considerable numbers. In the U.S.A.A.F. it is the UC-61A and the smallest in this category. A 165 h.p Warner Super-Scarab 7-cylinder radial engine powers those actually in service, but a later version with 200 h.p. Ranger in-line engine is now being produced. Top speed of the radial-engined model is 134 m.p.h., and it lands at 48 m.p.h. No armament is fitted.

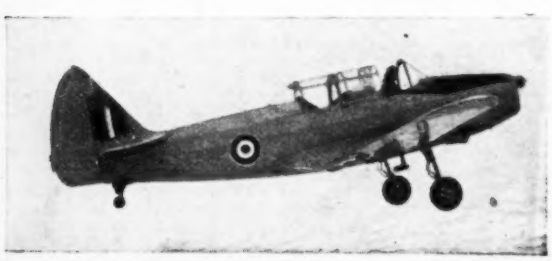
Recognition features include parallel-edged wings with semi-circular tips, well-tapered tailplane with round tips; slab-sided fuselage with short "radial" nose; wide, fixed unfaired undercarriage braced to wing struts, and thence to centre-section. Dimensions: Span 36ft. 4in., length 23ft. 9in., height 7ft. 3in., wing area 173 sq. ft.



Fairchild Argus (C-61A) Transport.



CORNELL (175 h.p. Ranger)

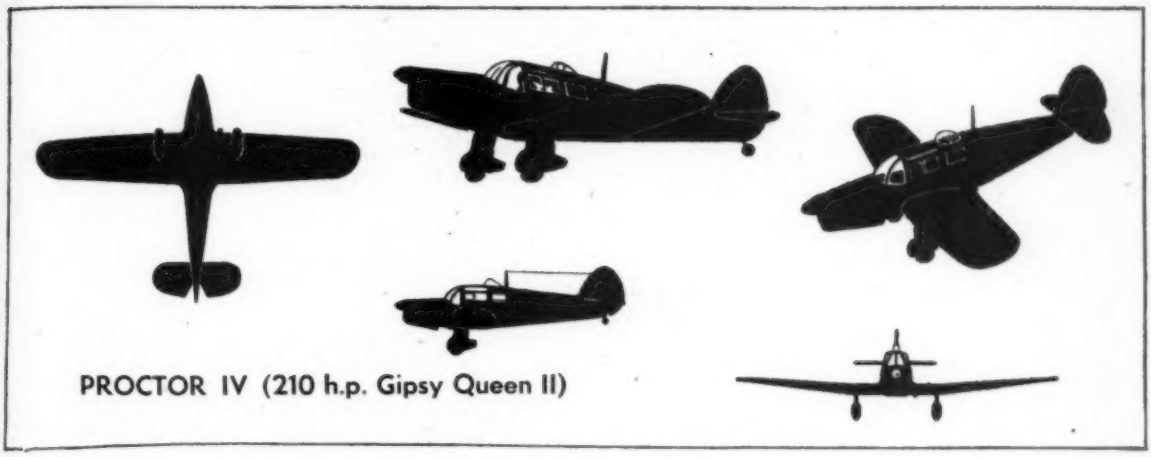


Fairchild Cornell (PT-26) Trainer.

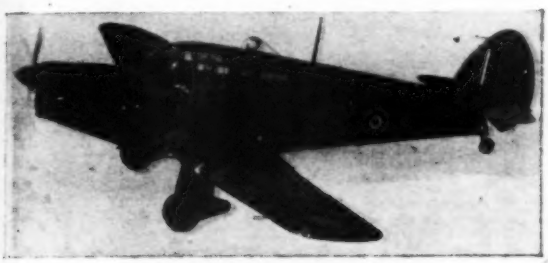
USED extensively by the R.C.A.F. as an elementary trainer, the Fairchild Cornell (PT-26) is powered by a 175 h.p. 6-cylinder inverted, in-line, air-cooled Ranger engine, and has a top speed of 115 m.p.h. It is really a modification of the American PT-23, which differs from it mainly in having open cockpits and a Continental radial engine. Some versions of the Cornell are now being fitted with the 200 h.p. Ranger, which gives a top speed of 123 m.p.h. There is no armament.

Recognition points include high aspect-ratio wings with only slight taper and blunt round tips; wide, flat centre-section carrying fixed undercarriage; wide, symmetrically tapered tailplane with round tips, and tapered fin and rudder with pointed apex; narrow, slab-sided fuselage with transparent cover over tandem cockpits. Dimensions: Span 36ft., length 27ft. 8in., height 7ft. 9in., wing area 192.5 sq. ft.

ying Attitudes



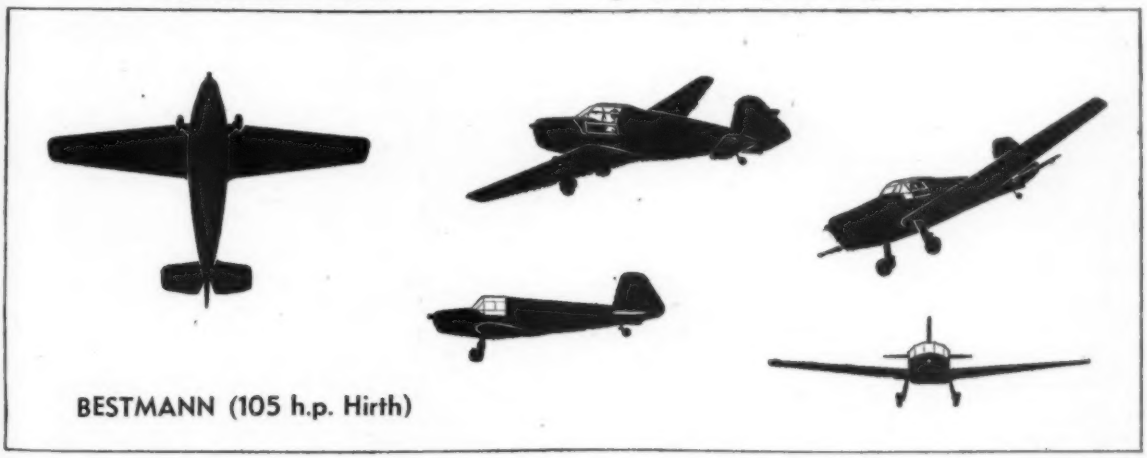
PROCTOR IV (210 h.p. Gipsy Queen II)



Percival Proctor IV Trainer.

DESIGNED to an Air Ministry specification as a wireless trainer for the R.A.F. and Fleet Air Arm, the Percival Proctor bears a strong family likeness to the Gull and Vega Gull. It has, however, a larger fuselage and a lower cowling, giving the pilot, seated well forward, a good view. Powered by a 210 h.p. 6-cylinder de Havilland Gipsy Queen II engine with c.s. airscrew, its top speed is 160 m.p.h. Without wireless training equipment it becomes a four-seater communications type. There is no armament.

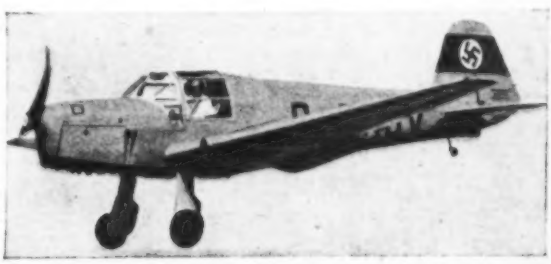
In plan and head-on views there is a strong similarity to the Cornell, but the tailplane is smaller, the nose more tapered, and the fuselage wider. Side view shows well faired cabin with rounded screen, curved fin and rudder, and "spatted" undercarriage. Dimensions: Span 39ft. 6in., length 28ft. 2in., height 8ft. 6in., wing area 202 sq. ft.



BESTMANN (105 h.p. Hirth)

CONSIDERABLE numbers of the Bücker Bü 181 Bestmann are in use at the flying training centres of the *Luftwaffe;* it is also used as a light two-seater communications type, and has a top speed of 133 m.p.h. Its engine is the 105 h.p. 4-cylinder inverted, in-line, air-cooled Hirth, and the type is also used for elementary training by the Swedish Air Force, these being built in Sweden and called the SK 25 primary trainer.

Wings and tailplane both have straight taper and square tips, the wings being of moderately high aspect ratio. Fin and rudder are large, angular and have a "raked forward" appearance; the wide, slab-sided fuselage has a rounded cabin top and is decidedly "tubby" in plan. There is no armament. Dimensions: Span 34ft. 9in., length 25ft. 5in., height 6ft. 5in., wing area 145.3 sq. ft.



Bücker Bü 181 Bestmann Trainer.

Continental Air Transport

Wartime Conditions : Present Position of the Lufthansa : Neutral Difficulties

By V. L. GRUBERG

FOR the second time in the course of twenty-five years the employment of aircraft as a weapon of war will influence profoundly the peacetime development of transport. But if the progress achieved by aircraft in the course of the last war was rather one-sided, and perhaps in many respects not altogether beneficial to its advance as an instrument of transport, this is not the case in the present global struggle.

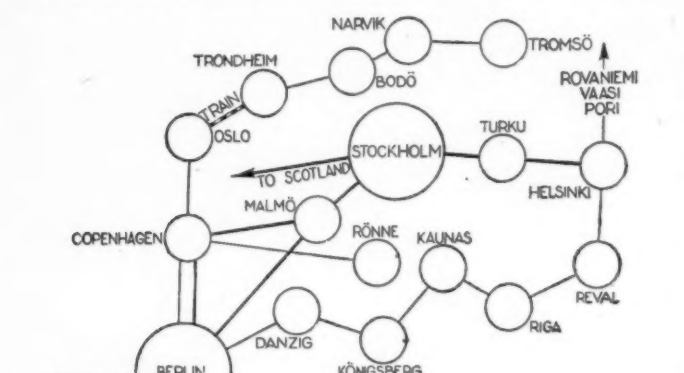
In the first world war the aspect of passenger and freight carriage was completely absent, and by the end of the war the product of this development—while asserting itself as a reliable flying machine—bore all the evidence of its one-sided, military nursery.

In the present war a tremendous wealth of designing, technical and operational knowledge is being gathered from experience with transport and bomber aircraft. This at a time when surface transport remains at best, at its pre-war level. The lead so gained by aircraft is likely to have a decisive influence on post-war transport development.

The technical progress of the last war laid the foundation for the rapid development of air transport during the span of peace that followed, and civil air transport was steadily forging ahead, year by year increasing its range of activities.

Although the underlying motives for this development were not always based on considerations of economy, by the time the world was thrown into the second war aircraft was firmly established as a carrier of first-class importance and of a unique character which in many respects made any competition with it quite hopeless. This does not only apply to transcontinental world air lines where the time element is an all-important consideration, but in some cases it is equally valid on internal routes where only aircraft can surmount the geographical difficulties which form an unconquerable obstacle to any other known method of transport.

At the outbreak of this war the net civil air communications numbered sixteen main lines, embracing practically the whole world. The total mileage of colonial, imperial, international and domestic routes operated to schedule by 1938 amounted to 388,076 miles.



In 1938 aircraft operating regularly in transport services throughout the world were estimated to have flown 2339,756,000 miles over routes some 350,000 miles long. They carried some 3,600,000 passengers and 165,000 tons of mail goods.

The effects of the war on Europe's civil air transport are manifold and can only be outlined here.

The loss of territorial sovereignty of a number of European states which fell victim to German aggression is the most striking of these effects. Some of these states maintained before the war a wide net of services both in and outside Europe. In some cases, such as Poland, the loss was total; in others, such as Belgium and Holland, operations in and from the metropolitan country ceased, while in their free colonial areas and dependencies, air transport was again resumed. On the other hand in a few countries under German domination, such as Denmark or certain satellite states, such as Rumania, some measure of independent air operations has been maintained.

Axis Isolated

During the six months preceding September 3rd, 1939, despite (or perhaps because of) the political situation, the Lufthansa enjoyed a measure of prosperity signified by a 3 per cent. increase in the number of paying passengers carried, and a 8.3 per cent. increase in passenger mileage. Lufthansa enterprises overseas prospered, and the trans-ocean service Bathurst-Natal had to be equipped with Bv 139 and Do 26 and was scheduled to operate by October 15th, 1939, twice weekly. A service between Berlin and Bangkok via Beirut, Basra and Karachi was opened in July and was planned to be extended to Tokyo. The outbreak of war interrupted that service.

The blockade imposed upon Germany, and the entry of the U.S. into the war, deprived the German Lufthansa not only of all her intercontinental air connections, but also of any possibility to establish such routes. No air

CONTINENTAL AIR TRANSPORT

services, scheduled or otherwise, are operated between the two remaining edges of the Axis, Germany and Japan, and no Axis-controlled airlines operate on any overseas routes except those maintained by Japan.

While thus Germany's transatlantic services ceased to exist with the outbreak of war, her overseas air empire crumbled down only gradually.

That this empire was by no means negligible may be realised from the fact that at the time of the breaking-up of German air transport enterprises in the period between 1939-1941, a net of 9,000 route miles in South America were operated by German-controlled or affiliated enterprises, or companies run by German nationals. In Peru alone the *Deutsche Lufthansa Succursal Peru* operated internal lines over 1,210 miles, and in 1940, 128,821 miles were flown.

On the European continent Germany still continued to maintain a relatively considerable net of air services.

In the first eight months of 1939 there was a notable expansion of the Lufthansa activities in an endeavour to tighten-up the link with the newly captured territories. New services were established to Austria, Danzig, Bohemia and the Saar; the night mail routes Berlin-Frankfurt, Berlin-Cologne and Breslau-Vienna were newly equipped,

Comparison of passenger traffic. Each symbol represents about 10,000 passengers carried on national air lines.

and the important Belgrade-Sofia-Istanbul service was opened.

For the first time, too, Focke-Wulf 200 and Ju 90s appeared in larger numbers. Nevertheless, in the summer of 1939 as many as 49 Lufthansa services were operated with Ju 52; four with Fw 200; seven with Ju 160, and the rest with Ju 86, He 111, Ha 139, Do 26, G.38, Fw 58, Me M-20, Ju F.13 and G.31.

With the outbreak of war all night mail services of the Lufthansa were suspended. The centre of gravity of German air transport shifted from the Reich proper to the area of dominated Europe, and inside Germany the network was drastically thinned out to make possible the operation of lines to war-important countries such as Italy, Scandinavia, South-East Europe and, for a time, Russia.

While in June, 1939, out of a total of about 81 passenger and mail services operated by the Lufthansa, 53 were inter-German connections, by 1942 70 per cent. of the network was situated outside the Reich proper. In the summer of 1939 the Lufthansa served about 22 European countries, and 12 of these services were operated in pool with non-German companies. The mileage of services inside the Reich amounted to about 21,000 miles, whereas that of services to centres outside Germany totalled almost 12,000 miles. The 1942 summer time-table shows that the Lufthansa served 33 large European centres, but only seven of these were cities in Germany proper, as against 32 German cities linked up to the Hansa system in June, 1939.

The two most important war routes are the Berlin-Munich-Venice-Rome and the Berlin-Stuttgart-Lyons-Marseilles-Barcelona-Madrid-Lisbon, linking up at Stuttgart with the Swiss service to Zürich. Both the Balkans and Turkey are connected to the Lufthansa network, and northward a service leads from Trondheim via Bodö-Narvik-Tromsö-Hammerfest to Kirkeness (920 miles).

In 1943 the network was reduced still further, but for military and administrative reasons a skeleton schedule was still maintained. By June of that year the German network showed a high intensity of services on the south-east axis, the main centres of traffic, apart from Berlin, being Vienna, Budapest and Bucharest. Vienna is, in fact, the main junction for Germany's air services to the Balkans, to the Protectorate of Bohemia and. to the Rumanian network. The connection from Berlin to Finland via Danzig, Königsberg, Kaunas (Lithuania), Riga (Latvia), and the route to Norway continued to operate, as well as the western connection to Italy and Lisbon.

Lufthansa or Luftwaffe?

It is extremely difficult to draw a line between the official courier services which are likely to predominate, the civilian lines and the transport system maintained by the Luftwaffe. In war generally, and in Germany in particular, regulations, priorities and the monopolising of accommodation have altered the normal aspect of civil air transport.

Not even all members of the diplomatic corps can make full use of the Lufthansa services as illustrated by a report in the *Slovak* (3.2.44) stating that newspapers take *a week or ten days* to reach the Slovakian Legation in Germany from Bratislava.

It is known that, in conformity with German war plans, a substantial section of Lufthansa personnel and equipment was militarised to build up the Luftwaffe's transport organisation. According to a Russian estimate one-third of Germany's transport aircraft were taken over by the Luftwaffe before the attack on the U.S.S.R., and it is safe to assume that the proportion has since increased.

During the first 131 days after the attack on Russia, transport aircraft in service with the Wehrmacht—many of them on loan from the Lufthansa—covered more than 12,750,000 miles and forwarded a total of about 60 million lb. of supplies.

As the militarisation of Lufthansa's personnel and equipment was effected on a basis of a financial agreement with the Luftwaffe, in some way it made up for the loss of other traffic. It is significant that in the first year of war the Lufthansa revenue from flying and other services was smaller by only 4.1 per cent. than in 1938, and had been mainly derived from so-called charters to the Luftwaffe. Another feature of the militarisation of the Lufthansa was the taking over of the maintenance and repair workshops by the Luftwaffe, which produced a revenue 41 per cent. higher than in 1938!

The Case of a Neutral

Swiss national air transport achieved in 1938 the distinction of an average number of passengers per aircraft of 7.9, a density higher than that in the U.S. The downward trend caused by the war is best shown by the fact that, compared with the last year of peace, as much as 80 per cent. of the Swissair fleet was lying idle in 1941. Among other difficulties the problem of aviation fuel, priority for which is given to the needs of the air force, has contributed to a further deterioration of the civil air transport.

In 1941 a modest schedule of operations was maintained on the Zürich-Munich route, later expanded to Zürich-Stuttgart-Berlin. The reopening of the Locarno-Rome service remained, however, within the sphere of projects.

A typical wartime feature is the jump in the ratio of direct subsidies to total revenue of from 12 per cent. in 1939 to 28 per cent. in 1940.

CONTINENTAL AIR TRANSPORT

The number of miles flown decreased in 1941, while revenue from passenger traffic increased, probably due to higher rates. In 1942 the total revenue of the company was higher than in 1941, but this was due mainly to increased subsidies and payment for work "executed for third parties," presumably by the Swissair workshops for the Swiss Air Force.

Another symptomatic wartime feature is the book value of the air fleet, which in 1941 was lower by about 22 per cent. than in 1940; because of the rapid modern development, it is explained—the Swiss equipment which is not being replaced at present becomes rapidly obsolete. This air fleet is composed of four D.C.3s with 1,150 h.p. engines, three D.C.2s with 750 h.p. engines, and one F VIIa, one D.H. Dragon and one A.C.4. While the American machines are being used on scheduled services, the A.C.4 is employed on charter, especially flights for sufferers of whooping cough, for which mountain flights are now a recognised cure.

Reports for 1943 indicated that most of the air traffic is moribund, the only remnant of the once widespread Swiss system being the Zürich-Stuttgart-Zürich line.

At the same time, the Swiss are not neglecting the post-war problems of their air transport. Because of the increase in range of commercial aircraft types it is feared there that Switzerland may lose her position as an air junction in the Continental European system, and will have to develop commercial air services so as to meet the needs of her own economy. To this end a project has been prepared for the extension and construction of airports at Zürich, Basle, Geneva and possibly Berne, to cater for international European landplane traffic and a central airport for transatlantic services.

For such revival of activities as may take place after the war, the Swissair company is meanwhile vigorously preparing a cadre of trained personnel. At its headquarters at Dübendorf courses are held for wireless operators, navigators, pilots and ground engineers, at which the traditionally high standards are maintained.

In Turkey the pre-war fleet of the *Services Aeriens Turcs* consisted of several D.H. aircraft. In July, 1943, *Vatan* reported an expansion of the company's activities and the purchase of eighteen aircraft, of which five were Ju 52s, the rest being American types. With this fleet new routes had to be tackled by the company: Ankara-Siwas-Erzerum; Ankara-Baghdad; Ankara-Adena-Lydda (Palestine) with connection to Egypt and beyond, and Ankara-Istanbul, the latter twice weekly.

A Newcomer

Incidentally, the first entirely Turkish-built passenger aircraft will shortly be put on the Ankara-Istanbul service.

The establishment of these routes marks a departure from the pre-war Turkish policy which was marked by air isolation. Foreign air transport companies endeavouring to secure the right of transit were repeatedly refused permission, and had to seek other routes. While probably this attitude was due to the fact that at the time Turkish aviation was still very retarded and could not benefit from the usual reciprocity agreements, the wartime expansion of the Turkish services is in future bound to bring Turkey to a closer relationship with the European and the Middle East air transport system.

In Spain the air services operating on the Iberian peninsula have never had a really national character. The Spanish *Compania Mercantil Anonima de Lineas Aereas*, formed after the Civil War, operated with aircraft obtained from Germany and was reported to be 49 per cent. in Lufthansa hands.

In 1941 the following places were linked by air services: Valencia and Palma, the capital of Majorca; Iviza, capital of the island Iviza in the Pityuse group, not far from the Baleares, with Palma and Valencia; Bata, capital of Spanish Guinea and Santa Isobel, capital of the island group of Fernando Po off West African coast in the Bay of Biafra.

PROPORTION OF SUBSIDIES TO TOTAL REVENUE (in %)

Country	1933	1937	1938	1939	1940	1941
Denmark ..	47.2	—	21.4	—	—	—
Sweden ..	30.7	°15.8	16*	13	12*	15*
Switzerland	—	13.8	11.3**	12.0**	28.0**	—
Italy (Ala)..	88.8 (1935)	55.6	56.3***	—	59.8	—
Lufthansa ..	58.1	40.6	37.0	34.3 (a)	50 (a)	—

° = In addition mail subsidies = 20.1%.
* = Direct subsidy, another 8.5% mail revenue.
** = ,, ,, ,, 18.8% ,, ,,
*** = ,, ,, ,, 20.3% ,, ,,
(a) = Approx. Germany does not publish mail payments, which are therefore not included here.

WAR EFFECT: The trend towards economic self-sufficiency of air transport has been reversed by wartime difficulties.

During the present war the state took steps to bring the company effectively under its control; in 1940 it purchased 51 per cent. of the company's stock, thus acquiring a controlling interest, the balance of 49 per cent. remaining in private hands. A recent report states that the rest of the shares of the Iberia Air Company have also been acquired by the Spanish government.

The activities ot the Iberia show the same regressive tendency which is apparent in other European countries. A report published by the Spanish Statistical Head Office shows a general reduction of traffic results during the first quarter of 1943 as compared with the average of 1942.

Scandinavian Effort

Despite its neutral isolation Sweden has been able to retain throughout the war some measure of air transport and is now entertaining plans for its post-war expansion. Wartime conditions did not leave Sweden's air transport unaffected, and a particularly hard blow was the German attack on Russia which caused the discontinuation of the Stockholm-Moscow service; incidentally this service had been operated by the A.B. Aerotransport in pool with the Russian "Aeroflot" for over seven years.

The process ot temporary interruption of services went on from 1939, and by 1941 all internal routes were dormant. Out of the entire network of the A.B.A. the only two remaining were the services operated to Finland and to Great Britain. The difficulty in procuring fuel and lubricants was, as in Switzerland, a limiting factor in the maintenance of normal operations; it was particularly acute during the first three years of the war. Another wartime feature common to other Continental air transport enterprises is the staggering allowance made annually for the depreciation of aircraft. Out of all proportion to the practice followed normally in peacetime, this may be justified either by a policy to provide for the replacement of the air fleet after the war or by an attempt to accumulate substantial reserves.

By 1942 the crisis in Swedish aviation was more or less over and the wave of optimism which swept the world did not leave Sweden untouched; the Swedish Government embarked upon a programme of promotion of flying.

For the fiscal year 1944-45 the Swedish government appropriated the sum of 4,700,000 skr. (of which 525,000 is for the A.B.A.) for civil aviation, as compared with 1,200,000 skr, allocated under this heading in 1943, half of which was for general promotion, training, etc. This policy is further exemplified by an extensive airport construction programme planned for the current year, under which are airports at Torslända, near Göteborg, Norrköping, Eslov, Bulltofta-Malmö and Karlstad will be considerably expanded.

The report of the Ministry of Transport point out that the Karlstad airport is to be completed in the course of 1944-45 and will be one of Sweden's largest airports. It

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is to be used as an alternative base on the Sweden-Britain service, and as an interim halt on the Stockholm-Oslo route. Sweden's largest airport is still the Bromma, outside Stockholm, which has one completed runway of 1,850 m. and another, of 2,000 m., will be completed by midsummer.

Early this year it was reported that Sweden proposes to enter the arena of intercontinental traffic. For this purpose a company has been formed with an initial capital of 12,000,000 skr. (£720,000) combining some fifty commercial, industrial and shipping firms. Of the share capital 80 per cent. was subscribed by circles close to the A.B. Aerotransport and about 20 per cent. by Göteborg shipping companies. It is worth noting that in Sweden the shipping companies are not to go out independently in search of air traffic business, but have linked up with the existing national company which retains its well-deserved leadership.

While the A.B. is in future to confine itself to operation of European services, the new concern, the *S.I.L.A.* has been granted a monopoly for a period of five years for all overseas services radiating from Sweden. The technical and operational side will be run by the A.B.A.

In a recent statement on the plans of the *S.I.L.A.* Captain Carl Florman, of the company's board of directors and managing director of the A.B.A., said that as soon as the war is over the first objective is to open a line between Sweden and the U.S. with the co-operation of other Nordic air companies. This service, with New York as its terminus, is envisaged to operate on two alternative routes, one via Iceland, Greenland, Newfoundland, and the other via Gt. Britain or S. Ireland direct to Newfoundland and New York.

The realisation of this project would thus introduce a new Scandinavian unit into the post-war air transport system.

Siebel Si 204

Trainer and Transport Aircraft : Conceived in Germany—Made in France : Slow Production

ECONOMY reasons were primarily responsible for the expanded production of the Siebel Si 204 which was developed to combine, in one, two urgent requirements of the *Luftwaffe*: the need for an advanced trainer and for a lighter type of transport aircraft. Designed by Dipl. Eng. Fecher in 1941 to comply with the simultaneous requisites of safety, reliability and performance, the aircraft has been since employed as trainer, transport and reconnaissance aircraft.

The Siebel Si 204 is an all-metal low-wing cantilever monoplane with twin fins and rudders and an undercarriage retracting into the engine nacelles.

It is powered by two Argus As 411 12-cylinder inverted Vee air-cooled engines of 440 h.p., each driving two-bladed v.p. airscrews. Heating equipment is provided, which is also used to supply heat to de-icing strips on the wing leading edges. The cruising speed of the aircraft is 210 m.p.h., maximum speed 225 m.p.h., and rate of climb 3,200ft. in 3.3 min. and 9,800ft. in 9 min. With an empty weight of 8,598 lb. and flying weight of 12,345 lb., the Siebel Si 204 has a ceiling of 24,600ft. and a range of 1,100 miles.

In accordance with its two main forms of employment, two versions have been developed, differing only in details of equipment and finishing.

(Above) G.A. drawing of the Siebel Si 204 D. Dimensions : span, 69ft.; length, 39ft.; height, 14ft.; wing area, 495 sq. ft. (Right) Inside the "flying classroom."

SIEBEL SI 204

The Siebel Si 204 D powered with two Argus As 440 h.p. engines.

The Siebel Si 204A transport and the 204D blind-flying, wireless and navigation trainer differ only in the internal arrangement and the cabin roofing. In place of the front luggage compartment of the A version the Si 204D has been given an extended glass house allowing good field of view for the training of combat pilots. Concurrently, the cockpit has been fitted with dual controls, and both the layout and number of instruments correspond to that customary in combat aircraft so as to avoid further transition periods after training. The cabin itself is equipped as a "flying class-room" for wireless and navigation training and has seating accommodation for five pupils.

The parent producers of the Siebel Si 204 are the *Siebel Flugzeugwerke*, of Halle. This company produced in 1937 the Fh 104 light five-seater cabin monoplane which served as a basis of development for the Si 204.

By the end of 1941, when the French aircraft industry was incorporated in the German war effort, the main share of production had been switched over to the *S.C.N.A. du Centre* and the production of the Argus engines was taken up by the Caudron-Renault group.

When the Farman aircraft plant at Billancourt, near Paris, was destroyed some time ago by Allied bombers, the substantial orders for Siebel Si 204 placed with *S.N.C.A. du Centre* were allocated to their plants at Bourges and Fourchamboult, but their output was unsatisfactory.

Some time last year it was reported that the production programme for the Siebel Si 204, planned to be completed by March, 1943, was so much behind schedule that the German authorities were forced to spread it to other French industrial units. In March, 1943, an order for 200 of this type was therefore placed with the *S.N.C.A. du Sud-Ouest*, builders of the Bloch 161 four-engined transport aircraft.

The destruction of the *S.N.C.A. du Sud-Ouest* aircraft plant at Chateauroux Deols carried out by R.A.F. heavies on the night of March 10-11th thus sealed up yet another source of the *Luftwaffe's* supplies. From photographic evidence of the raid it is clearly evident that the Siebel has lost an important home.

Mr. Burden is Optimistic

Predicts 20,000,000 Post-war U.S. Air Passengers a Year and Fares Well Below Present Rail Charges

SPEAKING of the need for more and larger airports in the U.S., Mr. William A. M. Burden, U.S. Assistant Secretary of Commerce, recently told the St. Louis Chamber of Commerce that in his opinion aircraft will carry about 20,000,000 passengers a year in the U.S. and that practically all long-distance travel will be by air at fares considerably lower than present railroad fares. He said in part:—

"It is extremely misleading to talk of aviation's future in terms of airplanes because of the vast differences between a huge trans-oceanic airliner and a thousand-dollar sport plane. But—for those who like to talk in terms of numbers—the Civil Aeronautics Administration soberly contemplates that within a decade after the close of hostilities the U.S. may well have a million military, commercial and private planes in active service. The number of military aircraft will, of course, depend upon our national policy and the state of world affairs. But it seems probable that under any conditions our Air Forces will have at least 50,000 combat and training planes in service. Before Pearl Harbour we had approximately 500 airline planes and 25,000 privately owned airplanes in service—a ratio of one transport plane to 50 private planes.

"If the ratio were to remain about the same in 1950, with an estimated 450,000 civil aircraft in operation, we would have 9,000 commercial transports and 441,000 private aircraft. Obviously the suggested total can be achieved only if the development of private flying is aggressively and successively prosecuted.

"The manufacturing facilities necessary to produce this number of airplanes on a one-shift basis might not exceed 10 to 15 per cent. of our present war-inflated industry—currently producing more than 8,000 planes a month, a high proportion of them large multi-engined bombers and transports. Such a slash necessarily means the forcing out of many of the less efficient producers. But if this estimate of 10 to 15 per cent. is achieved, we will have salvaged a significant portion of to day's aircraft plants and will have an industry five times the size of that before the war.

"The first entirely new transport models to make their appearance on the airlines will consist of perhaps four or five basic types varying in size with the kind of route for which they are intended. In appearance they will not differ from the transport airliners in use to-day, except that the tricycle landing gear will be standard, and pressurised cabins will be common in longhaul service.

"It is unlikely that really unorthodox designs will be seen in commercial service in the first post-war decade. The flying wing and jet propulsion have received much study, but the adaptation of these principles to commercial use seems some way off. Moreover, the giant airplane of 300 to 500 passenger capacity, though technically possible, appears to offer little economic advantage and to involve reduction in schedule frequency which results from using such large units.

"Once this first generation of post-war airplanes is in operation, the standard of airline service will be greatly improved. Safety should continue its sharply upward trend. Travel time will be greatly reduced. More important, passenger fares can be cut perhaps as much as 30 per cent. below present Pullman fares. These improvements in air transport services will mean that by the end of the post-war decade the average moderately well-to-do American will do almost all of his long-distance travelling and a substantial amount of his short-distance travelling by air. Excluding very short haul traffic as too difficult to forecast, we should transport by air in the U.S. some 20,000,000 passengers a year, or 70 per cent. of the pre-war Pullman traffic."

U.S. GIVES AIRCRAFT TO BRAZIL

ADMIRAL JONES INGRAM, commanding the 4th U.S. Fleet, handed to the Brazilian Air Minister five aircraft, the first of a squadron of 14 aircraft which the U.S. Government is presenting to Brazil.

Plywood and Plastics

Recent Developments in Moulding Aircraft Plywood : High-frequency Heating : The Gallay Glueing Process

By W. NICHOLS, A.R.Ae.S.

VARIOUS processes have been developed during the past few years to effect the bonding together of wood veneers in moulded plywood construction. These have been reviewed from time to time in *Flight*, the more recent work on the subject being "Plywood and Plastics."* Basically, the various processes used involve the simultaneous action of heat and pressure during the curing period, and practice and experience have indicated that with the correct application and control of such factors, excellent and consistent results can be obtained in the manufacture of both flat and curved plywood laminates. Even so, experiment and research have continued, and although the latest process originating from the U.S.A. and described herewith does not differ fundamentally from the earlier processes, claim is made for a new combination of the art and technique, resulting in an improved and more practical production process, and as such has been the subject of a current patent application.

Towards the end of 1942 the Thaden Engineering Company of America were commissioned to develop a still further simplification of the bonding process and one able to accommodate panels of considerably increased size such as were urgently required for the aircraft production programme.

The use of the autoclave for the new process was apparently forcibly ruled out of the question due to delayed deliveries and inadequate sizes, and it was therefore considered that simplification could be made over the autoclave system to effect a reduction in the high initial and operating costs involved.

It was also appreciated that pressure could be obtained in two principal ways; first, by the conventional hot-plate press system, or secondly, by the fluid pressure such as is used in the autoclave-bag process employing air, steam, or liquid under pressure, air being considered as the most desirable fluid medium because of its ready availability and simplicity. Resulting from this the idea was conceived of using a very minimum of air volume, confined in a thin flexible bag which would be restrained from expanding by the resistance of adjacent supporting surfaces, one of which would consist of the die or mould over which the work to be moulded would be placed. To keep these supporting surfaces from separating under the influence of the bag pressure, it became necessary to restrain them by providing a chamber or restraining frame with inter-connected and fixed walls, sufficiently strong to take pressure in all directions.

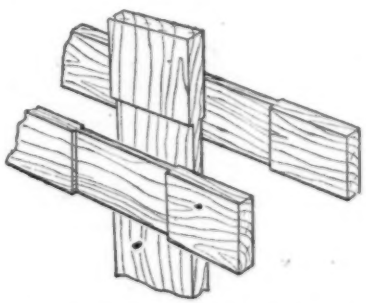


Fig. 1. Corner construction of the "Thaden" press restraining frame showing method of interlocking.

Equipment at Low Cost

In this respect an all-wood press was chosen due, of course, to the wartime conditions that prevail, comprising a series of hickory beams, self-connected as shown in Fig. 1, and requiring no metallic brackets or fastenings. In fact, a construction far from being the last word in "press" design, but worth mentioning inasmuch that it shows how economically the equipment for this process can be satisfactorily produced. Male and female dies may be curved or just two flat surfaces, and can be made of almost any rigid material, such as wood for preference, or, alternatively, concrete, plastic material or metal; further, the construction may be solid, honeycombed or trussed, providing sufficient strength and rigidity are present to carry the total pressure from the bag through to the press walls.

Electric Resistance Heating

The work to be moulded may be placed adjacent to either male or female die, depending on the most convenient circumstances prevailing, and as pressure of the air in the bag is increased the work is forced against the die, as will be noted from the diagram of the arrangement in Fig. 2. As the volumetric capacity of the thin bags used is extremely small, no particular hazard is involved in the event of the bag bursting or leaking, and, fortunately, leakage of dry air outward is not so deleterious on the wood products as steam or water would be. The pressure required depends primarily upon obtaining intimacy between the laminations to be bonded, but pressures of 55 to 100 lb. per sq. in. are being used.

The fluid pressure exerts itself uniformly over the entire surface of the work, and is roughly equivalent to double the pressure available with flat, rigid hot-plate platens, the reason being that such rigid platens bear only on the high spots of the varying thicknesses of the laminates, hence greater pressure has to be exerted to enable the platen surface to reach the valleys.

The pressure bag is generally made of a synthetic rubber-coated fabric with one or more outlets for rapid filling and discharging of the air. After considerable experiment and research this type of bag proved to be the best, being reasonably leakproof and of requisite strength, and is being used regularly from 100 to 200 cycles before replacement becomes necessary.

Most of the work to be used with this process called for a hot-setting phenol formaldehyde resin in which the heat required was 260 deg. F. to 300 deg. F. Thus, having obtained adequate pressure for the process, the next stage was to provide for the heat necessary to polymerise or "set" the resin glue. Naturally, steam would have been attractive for this purpose, offering, as it does, both heat

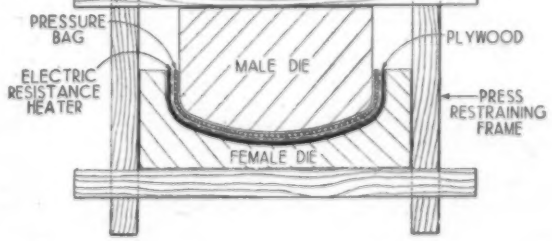


Fig. 2. Diagrammatic arrangement of the "Thaden" process for moulding plywood units.

* Plywood and Plastics, *Flight*, July 22nd, 29th, August 5th, 12th, 1943.

PLYWOOD AND PLASTICS

as well as pressure. This was, however, turned down after the hazards were considered of high-pressure steam, necessitated by 30 deg. F. and the possibility of leakage with damaging results to the work.

Thus it was finally decided to use dry air for the pressure medium, as already stated, and to incorporate an independent source of heat comprising an electrical resistance made up of narrow strips of metal. Such strips cover the area to be heated, and are proportioned in individual width to meet the electrical input and B.T.U. output requirements for a given time of moulding cycle and for a given temperature of the electrodes. The arrangement of the heaters varies according to the class of work being executed. For example, in some cases the heaters are placed between two or more pieces of work, or in other cases two heaters are used, one on either side of the work, the latter obviously being a most efficient arrangement which from the diagram of the process shown in Fig. 2 immediately suggests itself.

As with the earlier processes, time required for heat penetration by conduction into the work is primarily dependent on the total thickness of the work involved, the thermal conductivity of the wood veneer species, the moisture content and the rate of heat input. Heat must, of course, penetrate to the furthermost glue line away from the given source. Thus, as stated above, a heater system on each side of the work could be very efficient. Obviously the hotter the press is maintained, and the more residual heat that is stored in the press, the quicker the work will be brought to the desired temperature. Likewise, the hotter the press is kept, the faster must be the closing of the press or application of pressure to the work to obviate precuring of the near glue lines.

Applying Resin to Panels

Undoubtedly where flat panels or simple curved panels can be put under pressure in a matter of a few seconds, this new process would permit of a considerable residual heat being retained in the press, resulting in speeding-up the heat transfer to the work, and materially reducing the time of the bonding cycle, facilitated by the ease of control of the electrical resistance type of heater which has some desirable advantages in this respect.

From experience gained with the "Thaden" process so far, involving moulded units of varying thicknesses from $\frac{1}{8}$in. to $\frac{3}{4}$in., and with pressures varying between 50 to 100 lb. sq. in., the heating cycles have occupied from 12 to 50 minutes accordingly, the wood species that have been successfully moulded being hickory, maple, mahogany, poplar and gum. Other facts which have been brought to light are that for liquid glue a bonding temperature of 250 deg. F. is used, whilst this is increased to 300 deg. F. for film glue.

This process has been primarily evolved to cater for moulded units of much larger size than has hitherto been possible with earlier processes, and as a result involving fabricated sheets of such dimensions that applying the liquid glue with a brush is not consistent with modern production methods. Also glue-spreading machines, even if available in the sizes now required, would be less convenient than the method adopted with this process of spraying the liquid resin on the panels by spray gun. For this operation the panels are held vertically in convenient batches within a suitable jig, allowing the rapid removal of each panel as coated to reveal the next for spraying.

Evaluating the "Thaden" process in its present stage of development, it would seem that it affords an economic method of manufacturing single or multiple panels of flat or complex shapes and of much larger overall dimensions than has hitherto been possible. Greater thicknesses than about $\frac{3}{4}$in. are practical, but obviously require increasing curing periods to permit the heat to penetrate by conduction, and to obviate this it is suggested that the development of moulded plywood construction demanding increasing thicknesses will call for high-frequency internal heating. That being so, the all-wood construction of the press and dies—a feature of the "Thaden" process—should have a valuable dielectric quality.

At the present moment extraordinary interest is being shown in the application of high-frequency heating to the plastics industry, and undoubtedly in the near future it may be applied to moulded plywood manufacture.

This development, however, is a job for the radio engineer, and all the necessary research in respect of the construction and supply of the electrical apparatus is a job for the electrical manufacturer. So far as the operator is concerned, he may have nothing more to do than to "plug in" or "switch on."

It is, however, of great interest to review the improvements, advantages, and possible disadvantages that high-frequency heating will automatically bring about, especially in moulded plywood and laminated plastics manufacturing technique with which the aircraft engineer is mainly concerned.

High-frequency Heating

This revolutionary method of heating a non-conducting material comes about in this way. When a dielectric material is placed between the plates of a condenser to which an alternating potential is applied, the material becomes subjected to an alternating state of stress. The dielectric then holds a quantity of potential energy which may be released or discharged in a number of different forms; the major portion of the energy released, however, can appear as heat and the so-called "loss factor" is a measure of the amount of energy dissipated in this way.

The theory as to how an alternating electric field will cause the temperature to rise in the work being produced is beyond the scope of this article, for it involves discussions on polar and non-polar molecules and similar complexities. Also experts themselves differ in their explanation of the exact manner in which the molecular excitation takes place, thus causing the heat to be generated inside the material. Briefly, however, high-frequency currents produce heat in each individual particle of a mass of material, and further such mass of material becomes uniformly and homogeneously warmed up throughout its bulk. The molecules of the synthetic resins involved are not electrically symmetrical, and when such molecules are placed in an electric field they tend to align themselves in much the same way as small magnets in a magnetic field. In addition to this electrical asymmetry, when the molecule is placed in an electric field it tends to be distorted, or asymmetry is induced in it.

Advantages of New Method

When the field potential varies rapidly, molecules lying within the field will tend to vibrate as a whole and also tend to suffer cyclic distortion. Although movement as a whole is not generally possible, parts of these complex molecules can and do vibrate in sympathy with the variations in the field, and the amount of displacement induced. In other words, the degree of polarisation determines the value of the dielectric constant of the material. Part of the resistance to this polarisation, or the damping effect, gives rise to the dielectric loss in the material and is responsible for the absorption of energy and consequent rise in temperature. If the materials and conditions are kept constant, this tendency to vibrate depends only on the potential gradient. Therefore providing the potential gradient throughout the material is kept uniform, such material will heat uniformly throughout its mass. Perhaps the essential difference between high-frequency heating and conventional heating by conduction can best be described by regarding the former method as a process in which the rate of heating of each small portion of the mass depends on the value of the potential gradient through it, and therefore its rate of use in temperature is independent of the portion next to it. Providing the mass and potential gradient are uniform there will be no variation in tem-

PLYWOOD AND PLASTICS

perature throughout the mass and therefore no conduction or transfer of heat takes place.

High-frequency heating has already solved a long-standing problem of the plastics industry in the production of relatively thick mouldings. For example, the curing of synthetic resins is a function of both time and temperature, and with conventional methods of moulding, the outer layers in contact with the hot-press may become fully cured before the heat has penetrated to the interior. For this reason the majority of plastic articles in the past have been confined to a thin shell-like form. With high-frequency heating obviously this restriction is obviated.

Disadvantages of H.F. Heating

In the manufacture of plywood sheets and moulded plywood components high-frequency heating is a great improvement, not only because of the time saved in getting heat to the glue lines which are embedded in the wood—a poor conductor—but also because the radio-frequency power can be applied whilst the wood veneer is under pressure. Dielectric heaters of high powers (200-300 kW) have already been used in making plywood. In normal plywood manufacture the earthed top and bottom platens of the press together form one electrode and the "live" electrode consists of a thin metal sheet inserted in the middle of the stack or pile of sheets.

Additional advantages to be gained by the application of high-frequency heating are that lower pressures can be used, more intricate shapes as well as units of greater thicknesses can be satisfactorily and conveniently produced, and shortening of the moulding time cycles becomes possible.

On the other hand there are, of course, disadvantages with laminated plastics, for it will be appreciated that, as applied to the glueing of wood, it does not concentrate upon the glue lines but on the whole assembly. Therefore calculations of power requirements involve the physical properties and dimensions of the wood; also heat requirements are based not on the weight of glue to be heated or total area of glue line, but rather on the total weight and specific heat of the assembly, and the glue line becomes a negligible factor in such calculations.

Therefore the whole of the wood must become heated, this resulting in power losses of heat uselessly applied and moisture losses from the wood, although, if the plane of the glue line is set parallel to the electrostatic field, and perpendicular to the electrodes, power and time are saved.

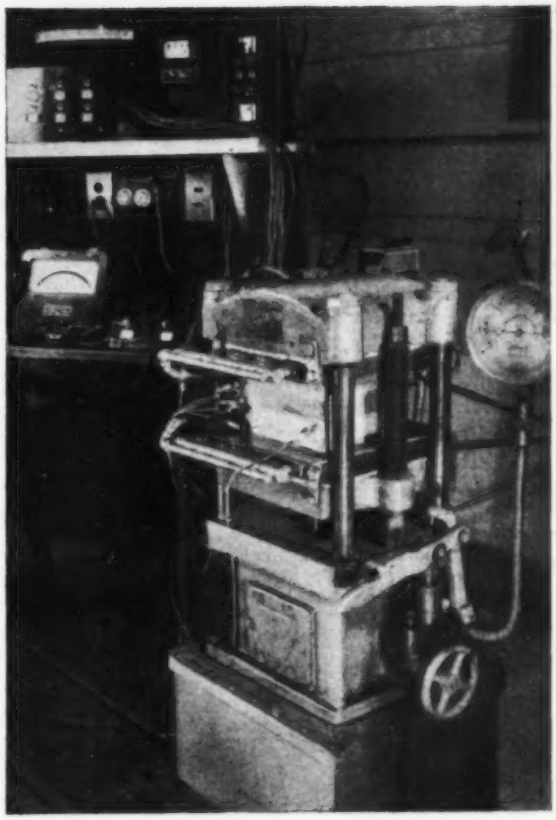


Fig. 4. Laminated wood being assembled by the "Gallay" process in a laboratory hydraulic press. The arrangement of glue lines in parallel should be noted.

Other disadvantages are that variation in moisture content of the veneers or laminæ results in variation in the temperatures produced. Furthermore, the electrodes must be thermally insulated for higher temperatures to avoid temperature differentials. Certain difficulties have apparently arisen with regard to flash-over in the squeeze-out, and safety precautions must be rigidly adhered to in view of the power used. Some of these difficulties will, of course, be overcome as further experience is gained from this method, but it does appear that the ideal solution for the application of heat is one that will concentrate entirely on the glue line without power losses and heat being uselessly applied. A portable radio heater such as is used in the plastic industry is shown in Fig. 3.

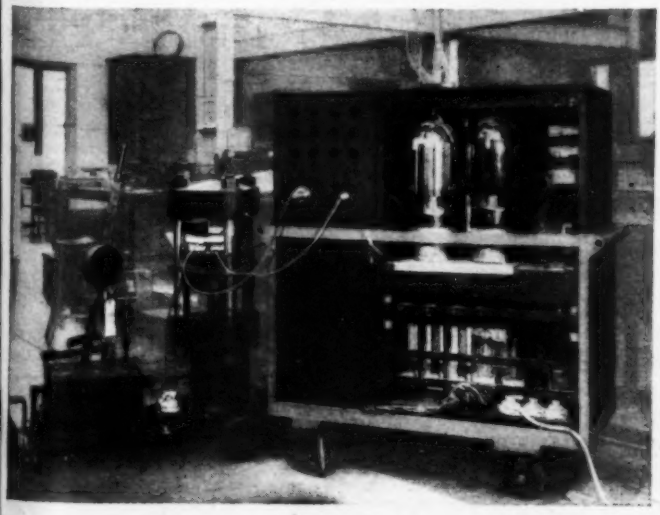


Fig. 3. A portable radio heater, by Rediffusion Ltd., used in the plastics industry for curing laminated paper blocks.

The Gallay Glueing Process

Such rapid advancement is taking place in the plastic industry that before high-frequency heating has fully become an established method, what promises to be the ideal solution already makes its debut, this time from Canada, by an entirely new method of glueing known as the "Gallay" process. This latest development is outstanding in its simplicity and ease of operation, requiring no new equipment or plant conversion and no specially trained personnel. The new method will even permit of hot glueing in a cold press and is entirely different in principle from high frequency heating, over which it shows definite advantages. Basically it utilises existing synthetic resin glues in a novel fashion in order to obtain optimum results, having regard for both quality and economy in manufacture.

In developing the process a method was sought by which the glue line could be heated directly.

PLYWOOD AND PLASTICS

In this respect electrical means appeared most feasible, and experiments were then carried out, using the glue line as a resistance. Synthetic resin glues in aqueous dispersion show a low continuity, decreasing to nil as the glue dries. The incorporation of finely powdered metallic conductors showed that conduction and heating effects were produced only at such high concentrations as to render wood-to-wood bonding action of the adhesive impossible. Moreover, such inserts expand with heat and contract after the adhesive has set, thereby setting up serious stresses in the glue line.

Hot-setting in Cold Press

Various carbon blacks and graphite were incorporated into glue dispersion without attaining the desired result, and finally acetylene black, manufactured by the controlled combustion of acetylene and showing quite remarkable electrical properties when dispersed in non-conducting materials, provided the answer. By special treatment, however, certain carbon blacks can now be rendered more highly conductive, and may be used in this process in place of acetylene black. A great variety of resin glues have been used in this process, including phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde and various mixtures of these resins. Both cold-setting and hot-setting resins have been applied, the cold-setting resins being generally heated to a temperature of approximately 225 deg. F. for a rapid cure, and hot-setting resins heated to slightly above that recommended by the manufacturers' instructions in order to decrease the setting times.

The current used is that directly obtainable in ordinary lighting and power circuits, either D.C. or 60 cycle A.C., the voltage used depending on the width of glue line, i.e., the dimension in the direction of current flow, 110 volts having been found ample for widths ranging up to 6in., and may be satisfactorily used up to widths of about 12in., but for widths of 18in. 220 volts become necessary, these figures being those used in the production of compressed laminated wood, an example of this assembly being shown in Fig. 4 and a fabric assembly by the same process in Fig. 5. For greater widths the distance may be effectively reduced and the necessary potential lowered by adding a third electrode. Time necessary to bring the glue line to the required temperature can be varied at will, and using a high voltage the power input may be made so large that the whole operation is completed in a few seconds. Using voltages of 110-220 with normal concentration of black, time under pressure may range from about 2 to 15 minutes, depending on conditions.

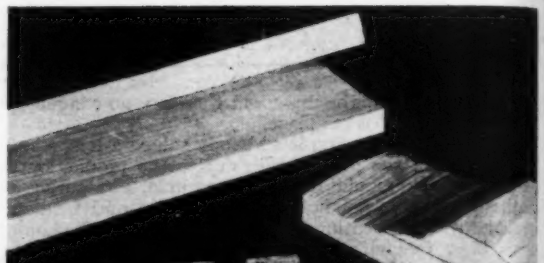


Fig. 6. Standard shear test specimens in compressed wood, "Gallay" process. Results proved that shear strengths were very good.

Advantages of "Gallay" Process

The electrodes used are generally copper wire of about 23 gauge, and usually arranged parallel with the edges of the wood and about ½in. from the edge, being stapled down over the edge of the wood at each end. Other types of electrodes can be used, including metal strip, or bar contacts outside of the work, etc. The pressures used in conjunction with this process are those already commonly used, and can be applied in the normal way.

For the application to plywood manufacture it is recommended that conducive carriers of fabric or paper should be introduced between flat plywood assemblies, acting essentially as extra "hot-plates." Conductive paper, for example, could be manufactured very cheaply, and could, if desired, be considered expendable. Thus a very large number of assemblies could be glued up simultaneously. Such a procedure would appear to offer many advantages for practical use.

High-density plywood, laminated wood, or compressed impregnated wood has attained considerable importance in certain applications. The Compreg must be manufactured in relatively thin layers, e.g., 0.5in., because of heat transfer considerations. The glueing of layers of Compreg can be effected by this novel process, using any resin adhesive which is suitable for the work. One point of difference arises in that the electrodes cannot be buried in the compressed wood, and the wires must therefore be inserted in grooves machined for the purpose, or other types of contacts must be brought in from outside the work. Results of standard shear test specimens in compressed wood are shown in Fig. 6.

The chief advantages of this new system may be summarised as follows: The process is very cheap in operation; heating is readily controlled, and the brief curing time required is independent of the dimensions of the assembly, heat being applied directly where required.

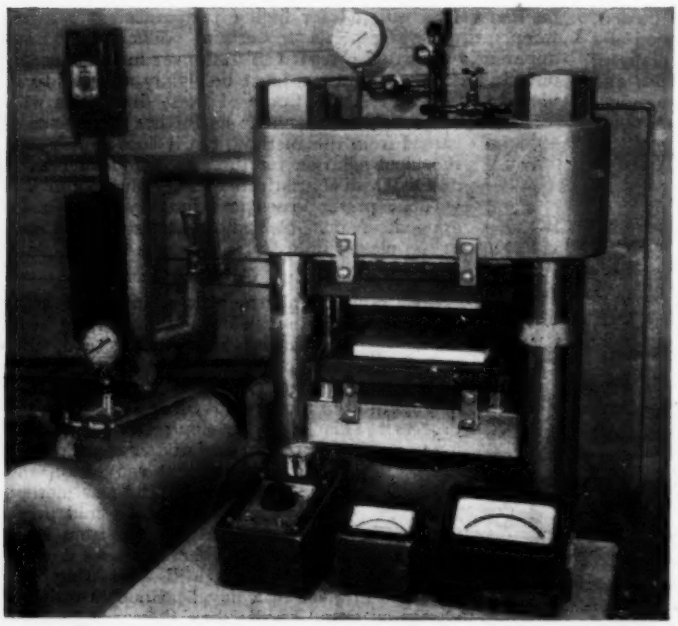


Fig. 5. Laboratory scale of assembly of a fabric laminate 6in. thick being cured by the "Gallay" process.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers not necessarily for publication, must in all cases accompany letters.

THE DUCTED RADIATOR

IN *Flight*, March 16, Mr. Hinings (Superintendent, Aero Engine Instruction, Rolls Royce), says: " . . . a freely suspended mock-up of a Townend ring . . . will move forward towards the wind-tunnel fan."

I had always taken it for granted that the fan was placed at the down-wind end of the tunnel, in order to minimise turbulence in the airflow. Apparently I am mistaken. The above statement implies that the forward pull, due to the aerofoil shape of the ring, exceeds the net drag.

Further on he says that owing to the heat energy imparted by the radiator to the air, the net drag may actually be negative, i.e., produce a forward thrust.

From the above two statements one can presumably take it that a ducted radiator will *always* produce a forward thrust. For years now I have read " proofs " of this forward thrust, but am still anxious to be convinced of its factuality.

M. C. BROTHERTON, Sqn./Ldr. (ex) R.A.F.

A.T.C. OFFICERS' DRESS

Limited Use of the Peaked Cap

MAY I draw attention to the farsightedness of the Air Ministry in permitting A.T.C. officers to wear peaked caps (except when on parade)?

The regulation dealing with the wearing of uniform by an A.T.C. officer allows him to do so only when on parade or when going on or coming off parade, and therefore the peaked cap may be worn only when travelling to or from parade.

The practice, with those who wear it, seems to be to set out from home with the peaked cap and only doff same the moment before parade: immediately afterwards another quick change act restores the coveted cap once more for the journey home—a tedious procedure smacking more of the music halls than the R.A.F.

Can it be that such types value their personal vanity higher than the dignity of this excellent Corps? If so, how simple the test in a future comb-out of unsuitable officers!

G. D. EVERINGTON.

JET PROPULSION FOR AIRCRAFT

Additional Reactive Thrust from Turbine

THE thrust source in rocket propulsion is quite evident to most *Flight* readers, and it is realised that it is due to the thermal reaction created by the combustion of a fuel containing all the necessary chemical elements required for the process.

With thermal jet propulsion the process is just the same; the reaction is due to the continuous combustion of the fuel and the oxygen content of the air delivered to the combustion system by the air compressor.

The reactive propelling force is generated by accelerating the whole of the working fluid in the combustion system and occurs even before the products of the combustion enter and drive the turbine, in the usual case where a turbine is used to drive the compressor.

Briefly, the power developed by the turbine is dependent upon the total mass flow of the fluid in slugs per second, the mean speed of the turbine blades in feet per second, and a turning moment force created by deflection of the working fluid in the blades of the turbine.

The fluid flowing through the combustion system must be rapidly accelerated as previously described and the propelling force is the result of the increase in the momentum impressed upon the fluid, and is given by:—

$F = SV$ and in flight, since the machine is in motion, by:—

$$F = \frac{SV}{v}(V - v)$$

Where F = Propelling force in poundals.
" S = Slugs, per pound, per second.
" V = Velocity of fluid in feet per second.
" v = Velocity of flight in feet per second.

But this is not the end of the story, just as deflection of the fluid in the turbine wheel creates a turning moment force in the turbine, so can a further deflection, towards the tail, create an extra forward propelling force on the aircraft.

When the working fluid leaves the rim of a radial flow turbine at high velocity, which will be a slightly lower velocity than the combustion velocity, and is deflected so as to exhaust towards the tail, a further strong propelling force is created which is given by: $F = S(V - v)$ (versine a).

Where F = Propelling Force, in poundals.
" S = Slugs, per pound, per second.
" V = Velocity of fluid in feet per second.
" v = Velocity drop in turbine.
" a = Angle through which the fluid is deflected.

When $a = 90°$, towards the tail, versine $a = 1$ and $F = S(V - v)$.

Since the fluid, turbine, and deflector move as one in flight, the propelling force is in this case independent of flight velocity. This extra deflection force can only be obtained by using a radial flow turbine, and the force thus generated is always additional to that generated by the usual processes.

Moreover, since the deflection force is generated subsequent to the combustion process and the driving of the turbine, the fuel consumption per poundal of propelling force actually generated is correspondingly reduced.

The higher the temperature at which the combustion process operates the more intensely the fuel and air burn, and the greater will be the acceleration of the working fluid and the value of the propelling force thus obtained.

Furthermore, the higher the temperature of the working fluid the higher the thermal efficiency at which the turbine operates, but high-temperature operation entails the solution of two problems, namely, improvement in the heat resistant properties of the materials used in the construction of the turbine, and the cooling of its wheel and blades.

Satisfactory solution of these problems amounts to the same thing in the end, for even if the heat resistant properties of the steel are improved, really efficient cooling of the turbine wheel and blades will enable still higher temperature working fluid to be used.

Early in 1940 *Flight* published a series of articles on turbo-supercharging* in which the supercharger was driven by a radial flow turbine, from which articles extracts and illustrations have been copied in the American and German technical press. In the turbine design referred to, unique methods for air cooling the rim and blades of the turbine at the point of maximum temperature, where it would be most effective, were provided.

This design, with its high thermal efficiency, high propelling force, plus high deflection force and reduced fuel consumption, appears to have been completely neglected.

" ULT PROSINS."

[* Turbo-supercharging, by F. Umpleby.—Ed.]

ROUND THE CLOCK BOMBING

Advantages of Daylight Raids

I WOULD like to offer my opinion regarding night raids by the U.S.A.A.F. as put forward by your correspondent R. L. Gladwell in the issue of *Flight* dated March 23rd.

First, let us compare the difficulties of night and day bombing. In the first we have the provision of lighted runways and all that goes to the getting of heavily loaded aircraft airborne at night; the long, hazardous journey calling for highly trained navigators in every aircraft; the locating of the target (for the " Pathfinders " this is no easy task), and, after bombing, the same long journey back to find and land on a flare-lit strip.

By day those difficulties are non-existent; there are many others, yes, but they can be *seen*! Now, all targets bombed in occupied territory must inevitably result in some loss of life to the people we are out to liberate. By day this can be reduced to a minimum by accuracy of bombing. By night the R.A.F. uses colossal " block busters " to devastate huge areas inside *Germany* proper, very few raids being made on occupied territory—surely for the above reason.

Then, again, in daylight the number of enemy fighters " available " to be destroyed is far greater than at night; we can bomb their airfields by night, but their wholesale slaughter in the air must be by day. Thus there may come a time when the effective fighter opposition of the *Luftwaffe* may be reduced to such a degree as to allow R.A.F. " heavies " to operate by day, with obvious advantage.

A switch-over by Bomber Command to day bombing would

CORRESPONDENCE

present none of the difficulties that a change to night bombing by the U.S.A.A.F. would entail. *Flak* would still take its toll, but saturation of the ground defences should be possible by sheer weight of bombs dropped. A thousand Lancasters and Halifaxes could inflict, if using the advantage of daylight, a much speedier knock-out of Germany's war production, with fewer operational "accidents." In fact, I see no reason why *all* bombing should not be by day in the near future.

Night bombing pays good dividends while the enemy has effective fighter opposition, but once that has been sufficiently destroyed surely daylight bombing offers even better.

V. H. IZARD.

THE WORLD'S BEST AIRCRAFT

Oldest Newtonian Law

I GREATLY enjoy your fine publication. In the February 24th issue Colin R. Barty states ". . . the functions of a good heavy bomber are to carry the greatest bomb load the longest distance in the least time . . ."

To this should be added I think ". . . and to *place* the bomb load so that the greatest strategic destruction of the target possible per ton of bombs carried is obtained."

With this fourth function considered, perhaps Mr. Barty would rate bombers in a different order?

LT. JOHN H. AUSTIN (Medical Corps).

Fortress or Mosquito?

THE D.H. Mosquito, we now know, can carry a 4,000 lb. bomb load and dump it on Germany. Then why not use this twin-engined two-man aircraft instead of four-engined Forts with crews of ten men to carry the same bomb load the same distance?

If the answer is that for daylight attacks it is necessary to have the greater ceiling of the big American bombers, I suggest that the greater speed of the Mosquito would probably result in fewer losses than those being sustained by the U.S. "heavies" in spite of their ceiling. News reports certainly indicate this, for whereas the U.S. Forts often sustain substantial losses, there are frequent accounts of Mosquito sorties described as having been carried out "without loss."

The saving in men, man-hours, and material per ton dropped would surely be enormous.

"REALIST."

Beaufighter Chosen for Night-fighter

I WOULD like to add my voice to Mr. Masefield's critics, but would first like to point out he asked for a reasonable attitude, without which the formula is obviously unworkable.

A category Mr. Masefield omits which I would include is night-fighter—in my opinion, most important. My choice is, of course, the Beaufighter. I also challenge his placing "tank-buster" in with "attack-bomber." I have split this category in two, as will appear in the list below.

Category	P. G. M's Choice	My Choice.
(1) Heavy Day Bomber	Liberator	Fortress II

Although on points the Liberator is away ahead, the fact that the U.S.A.A.F. has many more Fortresses is evidence that the Fortress has more "personality."

(2) Heavy Night Bomber	Lancaster II	Lancaster II
(3) Reconnaissance Bomber	Mosquito	Mosquito
(4) Long-range Anti-sub. Bomber	Liberator	Sunderland

The Sunderland has longer range and a fairly similar bomb-load. It has proved well able to defend itself!

(5) "Low Medium" Fighter	Mustang II	Spitfire IX.

The speed is similar; the Spitfire has lower wing loading; range and armament similar.

(6) "High" Fighter	Mustang II	Thunderbolt

The remarks on (5) apply here also, and in addition the Mustang cannot reach 45,000ft., as can the Spitfire V, let alone the Spitfire IX. I have awarded the Thunderbolt the palm on the strength of the turbo-supercharger.

(6a) Night-fighter	——	Beaufighter
(7) Single-seat Fighter-bomber	Lightning	Typhoon

The Typhoon is the better fighter-bomber; for the same reason it is the better fighter.

(8) Escort Fighter.	Thunderbolt.	Mustang.

This speaks for itself.

(9) Bomber Destroyer	Mosquito	Mosquito
(10) Night Intruder	Mosquito	Mosquito
(11) Two-engine Attack Bomber	Mitchell	Baltimore

The Baltimore is faster and has a larger bomb-load. Guns are not important in this class, nor is range.

(11a) Tank-buster	Mitchell	Hurricane IId

The large Mitchell is too cumbersome for this work.

(12) Land Torpedo-bomber	Beaufighter	He III

The He III is the only aircraft to carry two torpedoes.

In categories (13) to (22) I agree with P. G. M.'s choice.

The figures, therefore, are, out of 24 categories, American 12, British 11, German 1. Incidentally, why does everyone count the Norseman American? I have counted it British.

The "Mentions" are as follows: Mosquito 3, everything else 1. The Liberator goes from 2 to none; the Mustang from 2 to 1.

J. J. TOBIAS.

[The Norseman is Canadian designed and built.—ED.]

British Propaganda Campaign Needed

I AM afraid that J. C. Lund (*Flight*, March 23rd) does our American friends a grave injustice in his assertion that they "look down upon" the Avro York, and refer to it as a "Flying Box-car."

In my experience the phrase "Box-car" was employed in order to illustrate the load-carrying properties of the York rather than its appearance or performance. This is the sense in which the words have been used often in American magazines.

There is no doubt that the Americans are well aware of the reality of Britain's intention to be a leading figure in the battle for the supremacy of the post-war air.

I wonder how many readers are aware of the almost universal misconception in Canada that the De Havilland Mosquito is primarily a Canadian design and construction? I was amazed to discover that this was certainly the case some months ago when I was in that country training as a pilot.

It is about time that the British Government launched a large-scale propaganda campaign to "sell" British aircraft to the air-minded public of Canada and America.

W. B. RILEY.

Major Requirements

I READ P. C. Masefield's article reproduced in *Flight* of February 10th with great interest. Having gone through it about three times, I came to the conclusion that many of the statements were inaccurate and others not clear. Various things which are indispensable were left out of the major requirements list.

I started my list under the assumption that the designer of the particular aircraft knew what qualities were wanted for the duty the aircraft was to undertake. So I took all the requirements of the particular type—e.g. fighter speed, range, climb, manœuvrability, and worked them out as follows:—

	Sopwith Camel.	Fw 190.
Speed, m.p.h.	124 (38% of FW 190.)	390 100%
Range, miles	300 (56% " ")	525 "
Climb, ft. per m.	1,000 (33% " ")	3,000 "
Ceiling, ft.	19,000 (50% " ")	38,000 "
Armament	2 mgs. (or 20% " ")	4 cms. 2 gns. "
Manœuvrability	not known	
TOTAL—Camel, 38%		Fw190, 100%

This example, with the Camel, was merely for interest. By using this method I got the following list:—

Category.	Best.	Runner-up.
1. Heavy Night Bomber	Lancaster	Stirling.
2. Heavy Day Bomber	Fortress	Liberator.
3. Night Rec. Bomber	Mosquito	Me410.
4. Medium Bomber	Do217	Marauder.
5. Patrol Bomber	Liberator	Fortress.
6. Dive Bomber	Helldiver	Ju87.
7. High Altitude Fighter	Thunderbolt	Me109.
8. Medium Altitude Fighter	Typhoon	Fw190.
9 Twin engine Fighter	Mosquito	Me410.
10. Night Fighter	Mosquito	Beaufighter.
11. Naval Fighter	Seafire	Zero.
12. Torpedo Bomber	Beaufighter	Beaufort.
13. Flying Boat	Sunderland	B & V222.
14. Amphibian	Catalina	Do26.
15. Fighter Bomber (engine 1)	Typhoon	Fw190.

I know that this list will meet with a great deal of criticism, but to put an aircraft, built for a specific purpose, into specialised categories, can only be done with a certain amount of guesswork.

RAYMOND CHALLINOR.

SERVICE AVIATION

A Beaufighter II (Merlin engines) at H.M.S. *Cormorant II*, the Royal Naval Air Station of Gibraltar. The station is commanded by Cdr. (A) C. E. Eckersley-Maslin, R.N.

Royal Air Force and Fleet Air Arm News and Announcements

Awards

Far East

THE KING has been graciously pleased to approve the following appointments and awards in recognition of conspicuous service in operations against the Japanese:—

C.B.E. (Mil.)

Act. Air Comdre. S. WALLINGFORD, R.N.Z.A.F.

O.B.E. (Mil.)

Wing Cdr. E. M. LEWIS, R.N.Z.A.F.

M.B.E. (Mil.)

Flt. Lt. R. L. MEYNELL, R.N.Z.A.F.

Bar to Distinguished Flying Cross

Act. Sqn. Ldr. M. J. HERRICK, D.F.C., R.A.F.

Distinguished Flying Cross

Act. Sqn. Ldr. J. H. ARKWRIGHT, R.N.Z.A.F.
Act. Sqn. Ldr. J. A. OLDFIELD, R.N.Z.A.F.
Act. Flt. Lt. R. H. BALFOUR, R.N.Z.A.F.
F/O. A. M. DAVIS, R.N.Z.A.F.
F/O. L. A. RAYNER, R.N.Z.A.F.

Distinguished Flying Medal

Flt. Sgt. (now P/O.) T. E. GANLEY, R.N.Z.A.F.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

Bar to Distinguished Flying Cross

Major R. H. ROGERS, D.F.C., S.A.A.F., No. 40 (S.A.A.F.) Sqn.—Since the award of the D.F.C. Major Rogers has completed a further period of distinguished service. In January, 1943, he returned to the Middle East and during the advance to Tunis and later in Sicily and Italy he has participated in many operational sorties and obtained some valuable results. In August, 1943, he showed exceptional gallantry during a fire at a petrol dump when, owing to his initiative and prompt action much of the petrol was saved. Later in the same month he completed some brilliant reconnaissance work, enabling a ship of the Royal Navy to put a coastal battery out of action.

Act. Sqn. Ldr. C. G. ST. D. JEFFRIES, D.F.C., R.A.F.O., No. 155 Sqn.—This officer has taken part in numerous and varied operational sorties. Since March, 1943, as squadron commander, he has led his squadron on many bombing and escort duties over enemy targets in Burma. He has at all times set a magnificent example of courage, skill and determination, and his inspiring leadership has contributed greatly to the high standard of operational efficiency and morale maintained by his squadron throughout the monsoon period.

Act. Flt. Lt. A. G. BIRD, D.F.C., R.A.F.V.R., No. 268 Sqn.—Since the award of the D.F.C. this officer has continued to display outstanding courage on operations. During a sortie in April, 1943, he destroyed a Ju 88 and has since taken part in a number of tactical reconnaissance sorties which have involved deep penetration into enemy territory. Flt. Lt. Bird has also participated in many attacks on enemy land and sea transport.

Act. Flt. Lt. D. C. SAVAGE, D.F.C., R.A.F.V.R., No. 18 Sqn.—Since the award of the D.F.C. this officer has continued to display ability and enthusiasm and a capacity for hard work. He has been one of his squadron's most successful pilots on night intruder operations, on many occasions flying in bad weather over difficult country. He has frequently fulfilled difficult tasks during the Sicilian and Italian campaigns, and much of his unit's good work has been due to his efforts.

Sqn. Ldr. H. J. Sherard Beazley, No. 89 Sqn., who has been awarded the D.F.C.

Distinguished Flying Cross

P/O. J. L. BARTON, R.A.F.V.R., No. 76 Sqn.
P/O. C. E. BERRY, R.A.F.V.R., No. 158 Sqn.
P/O. J. H. BERRY, R.A.F.V.R., No. 100 Sqn.
P/O. A. C. F. BROWN, D.F.M., R.A.F.V.R., No. 156 Sqn.
P/O. H. C. CARD, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. C. R. A. CHALLIS, R.A.F.V.R., No. 158 Sqn.
P/O. G. W. COBURN, R.C.A.F., No. 83 Sqn.
P/O. R. W. CORKILL, R.A.F.V.R., No. 9 Sqn.
P/O. J. C. CORNHILL, R.A.F.V.R., No. 100 Sqn.
P/O. F. G. CROWHURST, R.A.F.V.R., No. 101 Sqn.
P/O. R. J. EDIE, R.A.F.V.R., No. 103 Sqn.
P/O. J. R. EVANS, R.A.F.V.R., No. 103 Sqn.
P/O. D. B. EVERETT, R.A.F.V.R., No. 35 Sqn.
P/O. C. S. FRANCIS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. W. H. GEORGE, R.A.F.V.R., No. 78 Sqn.
P/O. A. M. GLENDINNING, R.A.F.V.R., No. 158 Sqn.
P/O. H. C. HERNAMAN, R.A.F.V.R., No. 156 Sqn.
P/O. J. W. R. HILL, R.A.F.V.R., No. 101 Sqn.
P/O. P. A. F. JOHNSON, R.A.F.V.R., No. 101 Sqn.
P/O. D. A. JONES, R.A.F.V.R., No. 158 Sqn.
P/O. J. H. JONES, R.A.F.V.R., No. 426 (R.C.A.F.) Sqn.
P/O. T. KIDGER, R.A.F.V.R., No. 51 Sqn.
P/O. J. A. KIMBER, R.A.F.V.R., No. 57 Sqn.
P/O. L. J. LAWRENCE, R.A.F.V.R., No. 199 Sqn.
P/O. P. R. LYFORD, R.A.F.V.R., No. 156 Sqn.
P/O. G. J. S. MACMILLAN, R.C.A.F., No. 51 Sqn.
P/O. E. H. MAGNUS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. J. D. MCCORKINDALE, R.N.Z.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. J. H. MORGAN, R.A.F.V.R., No. 35 Sqn.
P/O. N. T. NEWTON, R.N.Z.A.F., No. 115 Sqn.
P/O. J. C. PALMER, R.A.F.V.R., No. 78 Sqn.
P/O. T. A. PEATFIELD, R.A.F.V.R., No. 619 Sqn.
P/O. K. A. S. PIPE, R.N.Z.A.F., No. 115 Sqn.
P/O. M. S. J. PORTER, R.A.F.V.R., No. 158 Sqn.
P/O. S. G. RATCLIFFE, R.A.F.V.R., No. 78 Sqn.
P/O. V. A. ROBINS, R.A.F.V.R., No. 78 Sqn.
P/O. D. A. G. SARGENT, R.A.F.V.R., No. 12 Sqn.
P/O. R. C. SLOGGETT, R.A.F.V.R., No. 78 Sqn.
P/O. P. H. SPINDLER, R.A.F.V.R., No. 51 Sqn.
P/O. A. C. SONDERGAARD, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. S. J. TRAFFORD, R.A.F.V.R., No. 100 Sqn.
P/O. G. VICKERS, R.A.F.V.R., No. 156 Sqn.
P/O. M. W. WARREN, R.C.A.F., No. 426 (R.C.A.F.) Sqn.
P/O. D. A. WEARE, R.A.F.V.R., No. 78 Sqn.
P/O. E. A. WEBB, R.A.F.V.R., No. 115 Sqn.
W/O. G. E. ADAMS, R.A.F., No. 625 Sqn.
W/O. M. T. FORAN, R.A.A.F., No. 166 Sqn.
W/O. W. A. E. HERBERT, R.A.F.V.R., No. 78 Sqn.
W/O. J. M. PANOS, R.A.A.F., No. 460 Sqn.
W/O. K. D. ROSE, R.A.A.F., No. 156 Sqn.

SERVICE AVIATION

W/O W. J. SIMPSON, R.C.A.F., No. 51 Sqn.
W/O. L. J. WATERS, R.A.A.F., No. 156 Sqn.
Act. W/O. J. A. M. ARCARI, R.A.F.V.R., No. 156 Sqn.
Act. W/O. T. A. AUSTIN, R.A.F.V.R., No. 199 Sqn.
Act. W/O. R. W. COZENS, R.A.F.V.R., No. 35 Sqn.
Act. W/O. E. PLILLIPS, R.A.F.V.R., No. 166 Sqn.
Act. W/O. K. B. SMITHERINGALE, R.A.F.V.R., No. 12 Sqn.
Act. Sqn. Ldr. B. G. ASTON, R.A.F., No. 544 Sqn.
Act. Sqn. Ldr. J. R. CANHAM, R.A.F.O., No. 625 Sqn.
Act. Sqn. Ldr. J. C. DAY, R.A.F.V.R., No. 625 Sqn.
Act. Sqn. Ldr. T. R. KING, R.A.F.V.R., No. 256 Sqn.
Act. Sqn. Ldr. S. MCNEILL, R.A.F.V.R.
Act. Sqn. Ldr. C. J. W. TAYLOR, R.C.A.F., No 407 (R.C.A.F.) Sqn.
Act. Sqn. Ldr. N. H. WALKER, R.A.F.V.R., No. 10 Sqn.
Flt. Lt. A. J. FINUCANE, R.A.F.V.R., No. 228 Sqn.
Flt. Lt. C. K. FITZGERALD, R.A.F.V.R., No. 172 Sqn.
Flt. Lt. H. F. KERRIGAN, R.C.A.F., No. 120 Sqn.
Flt. Lt. N. A. MERVYN SMITH, R.A.F.V.R., No. 224 Sqn.
Flt. Lt. G. G. ROSSITER, R.A.A.F., No. 10 (R.A.A.F.) Sqn.
Act. Flt. Lt. L. R. AUST, D.F.M., R.A.F., No. 224 Sqn.
Act. Flt. Lt. J. A. EDWARD, R.A.F., No. 50 Sqn.
Flt. Lt. E. J. FISHER, R.A.F.V.R., No. 179 Sqn.
Act. Flt. Lt. F. A. FORSTER, D.F.M., R.A.A.F., No. 83 Sqn.
Act. Flt. Lt. I. R. HARVEY, R.A.F.V.R., No. 106 Sqn.
Act. Flt. Lt. E. S. KELLY, R.N.Z.A.F., No. 102 Sqn.
Act. Flt. Lt. H. L. MATTHEWS, R.C.A.F., No 120 Sqn.
Act. Flt. Lt. K. RUSKELL, R.A.F.V.R., No. 50 Sqn.
Act. Flt. Lt. B. J. STARIE, R.A.F.V.R., No. 97 Sqn.
Act. Flt. Lt. K. M. STEVEN, R.A.F.V.R., No. 97 Sqn.
Act. Flt. Lt. N. D. WEBB, R.N.Z.A.F., No. 61 Sqn.
Act. Flt. Lt. C. P. WOOD, R.A.A.F., No. 90 Sqn.
F/O. T. H. BURDETT, R.A.F.V.R., No. 540 Sqn.
F/O. V. L. COLE, R.A.F.V.R., No. 106 Sqn.
F/O. K. W. L. FULLER, R.A.F.V.R., No. 100 Sqn.
F/O. F. E. HAY, R.A.F.V.R., No. 139 Sqn.
F/O. L. T. JOHNSON, R.A.F.V.R., No. 149 Sqn.
F/O. J. W. KING, D.F.M., R.A.F.V.R., No. 144 Sqn.
F/O. S. H. LETLEY, R.A.F.V.R., No. 44 Sqn.
F/O. K. S. MILLER, R.C.A.F., No. 404 (R.C.A.F.) Sqn.

THE KING has been graciously pleased to approve the following awards:—

M.B.E. (Mil.)

F/O. C. B. THORNTON, R.A.F.V.R., No. 141 Sqn.—In November, 1943, a Mosquito aircraft, carrying full operational equipment and long-range petrol tanks, crashed whilst taking off and immediately burst into flames. Soon explosions were occurring almost continuously owing to fuel tanks, cannon shells, and Verey cartridges being ignited. Blazing wreckage was being flung in all directions. F/O. Thornton, a pilot, was one of the first to arrive at the scene of the accident. Finding the navigator had been thrown clear, he made him comfortable, organised the medical party and supervised the injured man's removal to the ambulance. Then, with complete disregard of his own safety, this officer made straight for the main area of the crash, which was surrounded by barbed wire, and saw that the pilot of the aircraft was lying beside an engine with his clothing on fire. F/O. Thornton went through the wire into the middle of the wreckage to reach the pilot and, in spite of the great danger he was in, put out the flames on the pilot's clothing and removed his parachute. With assistance he then carried the pilot to an ambulance. Unfortunately, both the rescued airmen died later, but had it not been for the prompt and gallant action of F/O. Thornton, who sustained burns to both his hands, neither would have been rescued alive.

Lt. E. J. MACDONALD, S.A.A.F.—One night in October, 1943, Lt. MacDonald was one of the crew of a Wellington aircraft detailed for an exercise in Suez Bay. While the aircraft was at 300 feet above sea level, the port engine misfired and shortly afterwards failed altogether. The aircraft could not maintain height on one engine and was forced down on to the sea. Lt. MacDonald escaped from the astro hatch and noticed that the dinghy had broken away and, with a strong wind blowing, was rapidly drifting south. He immediately swam after it, but his efforts to retrieve it were unsuccessful. Returning to the crew he found the pilot and navigator in difficulties, the pilot suffering from a sprained ankle and partial paralysis of the leg. Lt. MacDonald inflated the navigator's life-saving jacket for him and then went to the pilot's assistance. The other members of the crew separated and swam towards the shore, but Lt. MacDonald unselfishly continued to assist his two comrades, his cheerfulness and words of encouragement inspiring confidence in them. He tied himself to his two colleagues and the three men made slow progress towards the shore. After six hours in the water the navigator threw off his life-saving jacket and swam away. Lt. MacDonald gave the injured pilot the extra life-jacket and together they continued their slow journey towards the shore, which was eventually reached after they had been in the water thirteen hours. Throughout the whole period in a rough, shark-infested sea, Lt. MacDonald displayed great unselfishness. His conduct is worthy of high praise.

George Medal

W/O. W. K. MCGRATH, R.C.A.F., No. 404 (R.C.A.F.) Sqn.—In December, 1943, W/O. McGrath was the navigator of a Beaufighter aircraft which crashed shortly after taking off on an operational sortie. The aircraft, which was carrying a full petrol load and bombs, disintegrated on impact and burst into flames. W/O. McGrath, who was uninjured, managed to extricate himself from his damaged turret and immediately went to the aid of the pilot. The pilot was unconscious and trapped in his cockpit, which was enveloped by flames. The control column had been forced into his stomach and his right foot was locked under the smashed rudder bar. Ignoring the danger from possible explosions, W/O. McGrath endeavoured to release the pilot. After unlocking the top hatch he moved the control column, unfastened the pilot's parachute harness and removed his right flying boot. Then by an almost superhuman effort, W/O. McGrath extricated the pilot from the wreckage and dragged him one hundred yards over very rough ground to safety. W/O. McGrath then proceeded to the nearest farmhouse to obtain assistance. This airman displayed conspicuous courage and his prompt action undoubtedly saved his comrade's life.

Flt. Sgt. A. W. MCGINNIS, R.A.F.V.R., and Sgt. H. WEBSTER, R.A.F.V.R., both of No. 88 Sqn.—In September, 1943, these airmen, who were in the vicinity of an airfield, observed an aircraft overhead with its starboard engine and mainplane on fire. The aircraft passed from view and crashed behind neighbouring trees. Commandeering a passing car, Flt. Sgt. McGinnis and Sgt. Webster proceeded to the scene of the crash. The aircraft was burning furiously and ammunition was exploding. In spite of this and of the danger that the bombs, which they could see in the wreckage, might explode at any moment, these airmen approached the aircraft to search for the crew. They found the wireless operator in the rear of the aircraft and succeeded in extricating him and in beating out the flames on his clothing. They also extricated another member of the crew who was lying in the burning wreckage, but was unfortunately dead. Flt. Sgt. McGinnis and Sgt. Webster then carried the wireless operator away from immediate danger and commenced to render first aid to him. While they were thus engaged one of the bombs exploded, and both airmen were thrown to the ground and hit by falling shrapnel. Undeterred, they continued to tend to their comrade. They laid him in a ditch farther away and stayed with him until an ambulance arrived. In circumstances of great danger Flt. Sgt. McGinnis and Sgt. Webster displayed coolness and outstanding gallantry, and undoubtedly saved the life of one member of the crew.

Act. Cpl. J. A. SINCLAIR, R.A.F.V.R.—In July, 1943, Cpl. Sinclair was a passenger in a Wellington bomber which caught fire whilst taking off. A forced landing was made with the aircraft in flames, and it became a total wreck. Although the petrol tanks were exploding and all had been ordered to stand clear, Cpl. Sinclair, displaying complete disregard for his personal safety, re-entered the blazing aircraft and was instrumental in rescuing two passengers who were trapped in the rear turret. In effecting the rescue Cpl. Sinclair sustained severe burns on the head and arms, and was subsequently in hospital for six weeks. He displayed great bravery in saving the lives of the two trapped passengers.

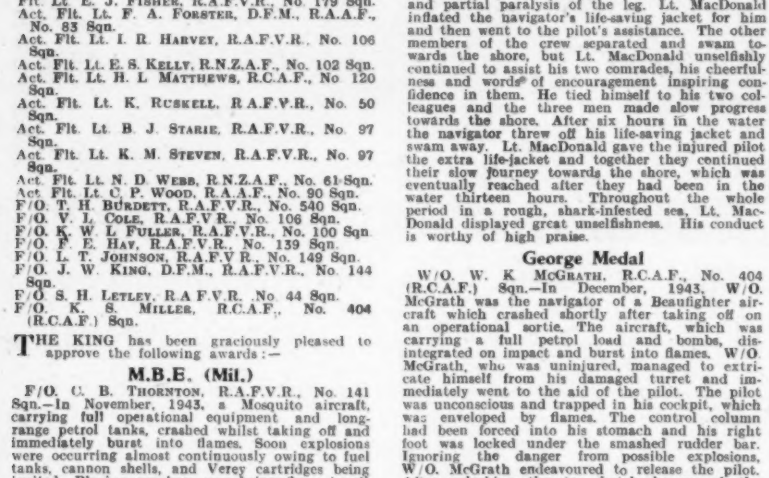
B.E.M. (Mil.)

Flt. Sgt. T. HALL, R.A.F.—In November, 1943, a Beaufighter aircraft, carrying a normal load of explosives and ammunition, crashed and burst into flames. Flt. Sgt. Hall, who was working in a nearby building, immediately went to the scene of the accident and endeavoured to rescue the pilot, who, although he had struggled half way out of the hatch, was dazed and unable to get clear. Flt. Sgt. Hall was driven back by the flames, but, persisting in his efforts, he eventually succeeded in pulling the pilot out of the aircraft and in assisting him to safety. In so doing, Flt. Sgt. Hall sustained severe burns to his face. His prompt and courageous action, which was performed with the knowledge that the aircraft was carrying explosives and ammunition, undoubtedly saved the pilot's life.

Sgt. E. V. SHARP, R.A.F.V.R.—One morning in November, 1943, Sgt. Sharp was the wireless operator of a Wellington aircraft which crashed and caught fire. The aircraft was fully fuelled and carrying ammunition and pyrotechnics. The crew, with one exception, managed to extricate themselves. Sgt. Sharp was just about to jump off the leading edge of the mainplane when the wing petrol tanks caught fire. At this moment, realising that one of his comrades was still in the aircraft, he returned through the fire and succeeded in pulling him out of the astro-dome on to the ground. In so doing he sustained injuries which necessitated treatment at hospital, but his gallant action saved his comrade's life.

Cpl. E. M. BOWER, R.A.F.V.R.—On two occasions this airman, while in charge of the crash tender, has shown outstanding gallantry in his attempts to save the lives of pilots by quelling the flames of burning aircraft. The first incident occurred in August, 1943, when two Typhoon aircraft, which had collided in the air, burst into flames on impact with the ground. The second took place in November, 1943, when an aircraft landed from an operational sortie with a bomb which had failed to release; the bomb fell off during the landing run, exploded, and set the aircraft alight. In the face of great danger from exploding cannon shells and petrol tanks, Cpl. Bower, on both occasions, showed fine courage and devotion to duty by approaching, without hesitation, very close to the burning aircraft to enable his extinguisher to reach the flames. His excellent example encouraged the other airmen engaged in the fire fighting, and enabled the flames to be subdued in a very short time.

Cpl. S. J. MATHEWS, R.A.F.V.R., No. 97 Sqn.—One night in December, 1943, this airman observed a Lancaster aircraft crash in a field. He immediately ran across several ploughed fields to reach the aircraft, which was by then burning fiercely. Cpl. Mathews succeeded in extricating the wireless operator and in pulling two other members of the crew from the blazing wreckage. Then after attending to the rear gunner who had been thrown clear and was dazed, Cpl. Mathews went to a telephone and reported the crash to his base. Later, he directed the fire tender and the ambulance to the scene. By his prompt and courageous action this airman saved the life of the wireless operator and rendered valuable assistance in most harassing and difficult circumstances.



FLEET FIGHTER FOLDED: A Vought Sikorsky Corsair of the Fleet Air Arm folds its wings before going below to the hangar deck.

L.A/C. W. H. GOODE, R.A.F.V.R.—One night in October, 1943, a Lancaster aircraft, returning from an operation, crashed on a beach. A crash tender was quickly on the scene. L.A/C. Goode being a member of its crew. The aircraft was found to be burning fiercely. Despite the danger from ammunition, which was continually exploding, the crew of the tender successfully extinguished the fire. There being no sign of any occupants of the bomber, an extensive search was made of the aircraft and also in the neighbourhood of the beach. The search in this latter area was a particularly hazardous operation, as the locality is heavily mined, and personnel had been "warned off" in orders. Throughout the fire-fighting work and during the subsequent search, which was undertaken in complete darkness, L.A/C. Goode showed a conspicuous example of courageous and enthusiastic leadership, displaying complete disregard for his own safety. On a more recent occasion he displayed similar courage and leadership when an aircraft crashed on a runway of his station and burst into flames. He made a prolonged attempt to save the pilot from the flames, and, although unsuccessful, he eventually was able to recover the body.

L.A/C. T. J. B. S. GILES, R.A.F.V.R., (R.A.F. Regiment), and A/C.1 L. J. WAITES, R.A.F.V.R. (R.A.F. Regiment).—In December, 1943, an Albemarle aircraft crashed when approaching to land on an airfield. The wreckage blazed furiously. L.A/C. Giles and A/C.1 Waites, who were employed in a gun post 200 yards away, immediately ran to the scene. Disdaining the intense heat and exploding ammunition, they climbed on to the fuselage to reach the seriously injured wireless operator, and succeeded in extricating him from his broken and burning turret and in carrying him away to safety. After removing the airman's burning shoes, A/C.s Giles and Waites returned to the blazing wreckage, but were unable to find any other occupants of the aircraft. These airmen displayed high courage.

Cpl. A. HOLDEN, W.A.A.F.—One night in October, 1943, a Wellington aircraft crashed about 150 yards from the flying control room at an airfield. Cpl. Holden, who was on stand-by duty as a radio telephone operator, immediately ran towards the burning wreckage. Just before she reached it the petrol tanks exploded, and fragments were hurled nearby her. In spite of this she continued on hearing cries for help, and she ultimately discovered the rear gunner trapped in his turret and enveloped by the flames. After some difficulty Cpl. Holden managed to open the escape door, but the gunner, whose clothing and harness were burning, was unable to get clear unaided. Ignoring the danger from the exploding ammunition and the intense heat, Cpl. Holden persisted in her rescue efforts, and eventually succeeded in dragging the airman clear of the aircraft and in escorting him to an ambulance. She displayed courage and devotion to duty of a very high standard, and but for her gallant action the gunner's life would have been lost.

THE KING has been graciously pleased to approve the following award in recognition of gallant and distinguished service:—

Distinguished Service Cross

Act. Flt. Lt. D. A. JONES.—Flt. Lt. Jones, as master in charge of a high-speed launch, has displayed outstanding ability and keenness over a long period. On June 6th, 1942, after a very arduous and hazardous journey, Flt. Lt. Jones rescued five airmen, the crew of a Stirling aircraft which had come down on the sea. On July 27th, 1942, Flt. Lt. Jones rescued seven members of the crew of a Halifax aircraft which had descended on the sea. His consistently high record of efficiency and courage has greatly inspired junior officers at his base and he has been particularly keen to carry out arduous and hazardous tasks.

Military Cross

Flt. Lt. F. F. E. YEO-THOMAS, R.A.F.V.R.

THE KING has been graciously pleased to approve the following award in recognition of gallant and distinguished services in Italy:—

Distinguished Flying Cross

Lt. (temp. Capt.) R. M. FARRER, Royal Regiment of Artillery.

Foreign Decorations

THE KING has granted unrestricted permission for the wearing of the undermentioned decorations conferred upon the officers indicated in recognition of valuable services rendered in connection with the war:—

Conferred by the President of the Republic of Poland

Krzyz Walecznych (Cross of Valour)

Act. Air Comdre. H. I. COZENS, A.F.C., R.A.F.
Act. Grp. Capt. M. W. S. ROBINSON, C.B.E., R.A.F.
F/O G. A. MARIN, R.A.F.V.R.
F/O. P. C. STANDEN, R.A.F.V.R.
P/O. F. H. TILLMAN, R.A.F.V.R. (since deceased).

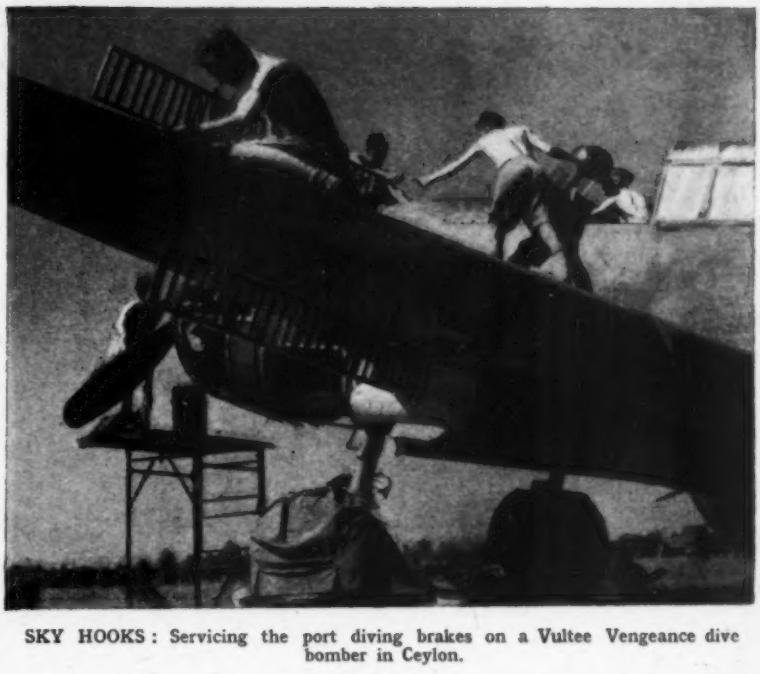
Conferred by the President of the United States of America

Legion of Merit (Commander)

Air Vice-Marshal G. G. DAWSON, C.B., C.B.E., R.A.F.

Legion of Merit (Officer)

Air Comdre. G. R. BEAMISH, C.B.E., R.A.F
Air Comdre. W. E. G. MANN, C.B.E., D.F.C., R.A.F.
Act. Air Comdre. G. L. CARTER, D.S.O., A.F.C., R.A.F.
Act. Wing Cdr. J. E. DUNNING, O.B.E., R.A.F.V.R.



SKY HOOKS: Servicing the port diving brakes on a Vultee Vengeance dive bomber in Ceylon.

Roll of Honour

Casualty Communiqué No. 367.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list, 120 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—W/O. F. Ash; Sgt. H. W. Birchley; Sgt. R. W. Chadwick; Sgt. W. S. Green; Sgt. D. P. Hewitson; Sgt. F. L. Hussey; Sgt. N. Taylor.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. G. W. Baxter; Flt. Sgt. W. C. Batkin; Sgt. C. L. Chalker; Sgt. M. L. C. Criswick; Sgt. B. I. Curnuck; F/O. H. C. Dillingham; F/O. R. H. V. Hogarth; Sgt. D. O. Humphries; F/O. E. A. Legrand; Sgt. S. W. Munn; F/O. E. C. North; Sgt. L. F. Paterson; Sgt. V. G. Trew; Sgt. R. H. Warrell.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. C. C. Adams; Sgt. R. Batterbee; Sgt. R. A. H. Bowring; Sgt. J. R. Boyes; Sgt. R. A. Buck; P/O. H. W. Chester; Flt. Sgt. A. Chilton; Sgt. D. Coles; Sgt. W. Collier; Sgt. A. G. Cox; Sgt. J. H. Davies; Sgt. F. W. Day; Sgt. G. J. Evans; Sgt. M. J. Fitzgerald; Sgt. J. T. Francis; Sgt. A. P. Gielty; Flt. Sgt. G. Gill; Sgt. P. J. Gillan; Sgt. E. R. Ginn; Sgt. L. J. Glover-Price; F/O. M. Gluck; Sgt. P. Hemingway; Sgt. W. W. Hill; Flt. Sgt. L. G. H. Hingley; Sgt. D. T. Horsfall; Sgt. J. Irwin; P/O. L. A. Johnson; Sgt. J. Jolly; Sgt. V. G. Leak; Sgt. P. R. Lissner; Sgt. R. J. McAuley; Sgt. S. McGlory; F/O. I. F. Mackenzie; Sgt. K. Mackintosh; Sgt. A. G. McManus; F/O. L. C. Martin; Sgt. C. J. P. Meyer; F/O. K. E. Moon; F/O. E. B. Oldham; Sgt. J. W. G. Parker; Act. Sqn. Ldr. E. G. Pett, D.F.C.; Sgt. A. J. Railton; Sgt. C. Ray; Sgt. D. A. Rayment; Sgt. J. Reddish; Sqn. Ldr. J. C. Richards; Sgt. M. Riley; Sgt. D. Scigal; F/O. D. J. Slaughter; Flt. Sgt. E. G. M. Smith; Sgt. T. R. M. Smith; Act. W/O. J. G. W. Swain; Sgt. C. Taylor; Act. Wing Cdr. A. J. Thomas; Sgt. R. B. Twitchen; Sgt. H. W. G. Vickers; Sgt. L. R. Vincent; Sgt. F. K. Whitall; Sgt. R. K. White; Sgt. A. E. Whittall; F/O. S. A. Willoughby; Sgt. R. Winn; Sgt. K. Wolstencroft; Sgt. E. Wright.

MISSING, BELIEVED KILLED IN ACTION.—P/O. L. Hocking; Sgt. P. McQueeney.

MISSING.—Sgt. L. F. Abel; Sgt. A. Abrahams; Sgt. D. K. Ashton; Sgt. W. T. Banner; Sgt. H. B. Bell; Sgt. R. C. Betts; Sgt. J. Boland; Sgt. W. C. Boot; Sgt. R. A. Boyden; Sgt. A. Brettell; Sgt. G. J. Bucknall; F/O. G. Cartwright; Sgt. R. Codling; F/O. A. E. Cook; P/O. F. Crothers; P/O. R. Dawson; Sgt. S. J. Degnan; Sgt. L. G. Driver; Act. Flt. Lt. H. C. Eaton; Sgt. E. W. Ebsworth; Sgt. D. J. Edwards; Flt. Sgt. H. T. Ellis; Flt. Sgt. D. Entwistle; F/O. B. Findley; Sgt. D. G. Forster; Sgt. J. S. Fraser; Sgt. P. C. Gizzi; Sgt. W. Good; Sgt. W. A. Goodfellow; Sgt. J. Gorrie; F/O. R. E. Hicks; Sgt. A. J. Holdom; Flt. Sgt. J. W. Homewood; W/O. D. J. Hughes; Sgt. F. Hughes Sgt. J. H. Hymas; Sgt. R. C. J. Iles; F/O. R. H. Irvine; Sgt. S. R. Jessamy; Sgt. J. I. Jones; F/O T. C. Laing; P/O. J. Lanaghan; Sgt. D. Logue; Sgt. K. A. Lowery; Sgt. J. McDermand; Sgt. A. W. Mackenzie; Sgt. A. A. Mansfield; Sgt. C. Mason; Sgt. L. R. H. Michell; Sgt. A. M. Miller; Sgt. W. T. Morgan; Sgt. J. D. Morris; Sgt. P. Neil; Sgt. J. E. Nowell; Sgt. J. O'Sullivan; Sgt. J. H. Paul; Sgt. G. A. Porter; F/O. J. A. Price; F/O. H. B. D. Pringle; Sgt. N. Pyke; Sgt. D. P. Rance; Sgt. J. T. Ravenscroft; Sgt. G. W. Rawlings; P/O. J. M. Read; Sgt. A. W. Reedman; F/O. E. A. Rose; Sgt. J. Rose; Flt. Sgt. R. J. Rouse; Sgt. C. P. Ryan; Act. Flt. Lt. W. W. Ryder; Sgt. R. R. Scotland; Sgt. F. J. Seeley; F/O. R. W. Sharp; Sgt. G. A. Shield; Sgt. R. Shields; Sgt. J. M. Smith; Sgt. R. L. Smith; Sgt. K. C. Southward; F/O. R. E. Stacey; Sgt. R. R. Stevens; Sgt. T. R. Stones; Sgt. A. C. Stopp; Flt. Sgt. R. W. Sutton; Sgt. J. W. Swann; Sgt. R. Symcox; Sgt. C. H. Thomas; Flt. Sgt. B. S. Tugwell; Flt. Sgt. P. W. Upton; Sgt. C. Walker; Sgt. J. C. Webber; Sgt. G. West; Sgt. L. J. Wilson; Sgt. A. E. Wortley; F/O. H. Wyatt; Flt. Sgt. N. Yates; Sgt. W. O. Yorke.

KILLED ON ACTIVE SERVICE.—Sgt. C. W. Batten; L.A/C. P. A. Carter; Sgt. L. W. Gransden; F/O. D. Herring; Sgt. D. J. Hurley; Sgt. J. S. Lemon; Sgt. D. Sanderson; W/O. H. F. Searle; Sqn. Ldr. D. J. Stewart; F/O. D. E. Wills.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. J. Booth; P/O. C. J. Hamment; Cpl. M. Maley; L.A/C. F. A. Moore.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. A. Coldman; F/O. C. Kerigan; Flt. Lt. J. E. F. Law; Sgt. A. E. Parkins; Act. Flt. Lt. D. White, D.F.C.; L.A/C. E. Wyver.

DIED ON ACTIVE SERVICE.—A/C.1 C. R. J. Cawley; L.A/C. H. McKnight; L.A/C. H. J. Riseborough.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. R. B. Hudson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. W. Addinsall; F/O. R. E. Dollar; P/O. S. H. Elliott; F/O. G. B. Herring; Flt. Sgt. J. S. Huggard; Flt. Sgt. D. H. Milne; Flt. Sgt. F. J. O'Grady; P/O. N. F. Robertson.

MISSING.—Flt. Sgt. E. C. Clunas; Flt. Sgt. E. W. Hurley; F/O. B. R. James; Flt. Sgt. C. B. Jeffery; P/O. J. A. Kerby; W/O. R. J. Power; P/O. S. Whiteside; F/O. A. H. Will; Flt. Sgt. J. F. Worley.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. N. F. Westhoff; Sgt. J. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. S. W. Bartlett.

SERVICE AVIATION

Royal Canadian Air Force

KILLED IN ACTION.—F/O. V. Adamic; F/O. F. E. Dawson; Flt. Sgt. R. H. Garnham; W/O. L. J. Upshall.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. A. Cline; Sgt. R. D. Fraser; Sgt. K. L. Garman; P/O. J. Gedak; P/O. T. J. Hughes; P/O. H. M. Ivatt; Sgt. H. T. Jacobsen; Sgt. J. H. S. Joannette; Sgt. E. H. McConnel-Taylor; Sgt. W. R. MacDonald; Flt. Sgt. D. P. McLachlan; Sgt. J. Martin; Flt. Sgt. J. R. O'Leary; P/O. J. B. Pettigrew; F/O. L. T. E. Sweet; P/O. C. R. Trask; Sgt. A. P. Uditsky; Sgt. S. L. R. Whitehead; F/O. B. J. Wright.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Cpl. H. S. Butler; W/O. B. V. Crist.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. R. B. Irwin.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. A. Williston.

MISSING.—Sqn. Ldr. D. MacK. Arnot; Flt. Sgt. W. L. Baker; Flt. Sgt. R. A. J. Bennett; Flt. Sgt. J. F. Blair; W/O. J. B. Chess; F/O. A. L. Clogg; Flt. Sgt. J. J. W. Couture; Flt. Sgt. T. W. Dodd; Sgt. R. W. Edwards; Sgt. W. E. Fell; F/O. A. R. Fisher; P/O. L. S. Gray; F/O. N. G. Czowski; W/O. M. F. Headly; Flt. Lt. A. G. Hermitage; Flt. Lt. A. G. Jira; F/O. W. S. Johnston; P/O. L. W. W. Jones; F/O. J. G. Y. Lavoie; F/O. E. L. MacWeigan; F/O. R. J. McMehen; Flt. Sgt. M. Marks; Wing Cdr. A. N. Martin; Flt. Sgt. L. W. Mattin; Sgt. B. R. Morrison; F/O. C. K. Nelson; P/O. R. O. Nickerson; F/O. L. W O'Neill; F/O. G. B. Pronger; Flt. Sgt. F. F. E. Reain; F/O. B. A. Russell; F/O. C. L. Scott; F/O. L. G. Speyer; Sgt. R. H. Stanley; Flt. Sgt. J. Sutherland; Sgt. S. J. Swain; F/O. W. V. Thom; Flt. Sgt. W. B. Tobin; F/O. C. Travers; Flt. Sgt. R. H. Walton; F/O. V. M. Warwick; Flt. Sgt. R. N. Weir; Sgt. J. A. Wilson; P/O. K. C. Wilson.

KILLED ON ACTIVE SERVICE.—Sgt. R. W. Burton; Sgt. G. F. Couse; F/O. C. L. McNeil.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. W. M. Maisenbacher; W/O. F. J. Morrow; F/O. W. R. Post.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. E. Vincent.

DIED ON ACTIVE SERVICE.—F/O. D. W. Woodward.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. I. H. Alexander; Sgt. M. W. Bentley; F/O. G. J. Moorhead; Flt. Sgt. I C Salt.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. R. Bluett.

South African Air Force

KILLED ON ACTIVE SERVICE.—Lt. E. R. Aitchson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Lt. C. S. Connel.

Casualty Communique No. 368

Of the names in this list 121 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Act. Flt. Lt. A. E. Allson; Sgt. H. R. George; F/O. H. C. Jewell; P/O. H. W. Miles.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Act. Sqn. Ldr. F. H. Bowden, D.F.C.; Sgt. D. W. Covell; Sgt. T. F. Cummins; Sgt. R. G Goff; Sgt. W. G. Trowbridge; Sgt. R. A. W. Wilkinson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. J. E. Atkins; Sgt. S. Barham; Sgt. E. Betts; Sgt. J. A. Bolton; Sgt. T. F. P. Boynton; Sgt. A. J. Britton; Sgt. C. E. Bryant; Sgt. D. C. Butlin; Sgt. A. Camps; Sgt. O. Cave; W/O. C. M. Colburn; Sgt. P. E. Collingwood; Sgt. W. J. Colwill; Sgt. G. T. Cook; Flt. Sgt. L. Debotte; Sgt. R. F. A. Dobson; F/O. W. J. Dowdell; Sgt. A. J. Dunn; Sgt. R. L. Edgoose; Sgt. A. W. Erne; Sgt. R. D. Evans; F/O. R. C. Farrant; Sgt. J. Fitton; Sgt. J. Flux; Sgt. S. Foster; Sgt. J. E. Foy; Sgt. R. W. Freeman; Sgt. K. J. Frost; Sgt. D. Galley; Flt. Sgt. R. F. Garrod; Sgt. W. V. Gerrard; Sgt. D. A. H. Gough; Sgt. L. P. Grace; Sgt. F. Grant; Sgt. A. R. Graves; Sgt. P. Hall; Flt. Sgt. J. Hancock; Sgt. L. G. Hardy; Sgt. R. E. Haywood; Sgt. A. K. Henderson; P/O. N. E. Hill; Sgt. H. Hinett; Sgt. H. T. G. Hubbard; Sgt. J. Hudson; Sgt. G. M. Hughes; Sgt. R. H. Ingram; Sgt. J. Jones; Sgt. T. E. Judd; Sgt. K. W. Jury; Sgt. P. C. P. Kipling; Act. Sqn. Ldr. F. J. Knight; F/O. R. K. Lamb; F/O. W. L. Leeman; Sgt. A. R. Leslie; Sgt. N. E. Lind; Sgt. T. E. Lloyd; Act. Sqn. Ldr. J. C. Mackintosh; Sgt. S. Moore; P/O. J. R. Morton; Sgt. F. Oakley; F/O. L. P. Oldham; P/O. P. J. Page; F/O. C. V. Parsloe; Sgt. P. B. Pearson; Sgt. W. J. Pelham; F/O. J. Phillips; Sgt. A. J. Polfrey; Flt. Lt. L. J. Porter; Sgt. H. F. Poynter; Sgt. J. W. G. Reeve; Flt. Sgt. J. Rennolds; Sgt. W. Robinson; Sgt. H. Roots; P/O. E. R. M. Runnacles; Sgt. J. Shields; Sgt. A. G. W. Smith; Sgt. S. Smith; Sgt. G. Sparrow; Sgt. H. Stripp;; Sgt. D. W. Suffling; Sgt. J. Thomson; F/O. T. B. Tomkins; Sgt. C. E. Tomlin; P/O. W. Towse, D.F.M.; P/O. J. B. True; F/O. L. W. Vinden; Sgt. J. S. Warburton; Sgt. J. W. Waters; Sgt. D. Webster; F/O. T. C. Wheelhouse; Sgt. R. A. Whellams; Sgt. S. Whitelock; Sgt. H. Wilford; Sgt. P. E. Wilkins; Sgt. A. R. Williams; Sgt. E. F. Williamson; Flt. Lt. H. F. Withy; Flt. Sgt. P. Woodcock; Sgt. J. H. Wright; P/O. I. A. Wynn.

WOUNDED OR INJURED IN ACTION.—Sgt. B. E. Challis; Sgt. K. Hall-Brookes.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. J. A. W. Turnbull.

MISSING, BELIEVED KILLED IN ACTION.—Sqn. Ldr. A. M. L. Alderton.

MISSING.—Sgt. F. T. H. Adams; Flt. Sgt. A. W. Archer; Sgt. G. Armstrong; Sgt. C. J. Barron; Sgt. K. W. Barry; F/O. B. A. W. Beer; D.F.C.; Flt. Sgt. H. G. Bell; Sgt. K. Bray; Sgt. L. R. Bright; Sgt. R. G. Brown; Sgt. A. A. Burgess; Sgt. R. E. Burke; Sgt. S. Cameron; Sgt. E. Campbell; Sgt. E. G. Cane; Sgt. A. W. Canty; Sgt. R. J. Charters; Sgt. K. R. Corbett; Sgt. J. R. Craig; Sgt. H. Deakin; Sgt. H. L. Duff; Sgt. T. E. Edwards; Sgt. A. E. Elms; Sgt. J. Falconer; F/O. F. G. Fidler; P/O. T. V. Finn; Flt. Sgt. G. W. H. Ford; Sgt. W. Fraser; F/O. M. G. Gladwell; Sqn. Ldr. H. W. Goule, D.F.C.; Flt. Sgt. C. H. Gow; F/O. C. Grannum; Sgt. H. J. C. Gwyn; Sgt. J. A. Haylock; Sgt. H. Hill; P/O. R. G. Hoare; Flt. Sgt. J. G. Hodgkinson; Sgt. H. S. Howie; F/O. J. Inston; Act. Flt. Lt. S. James; Sgt. D. W. Jenkins; Sgt. J. M. Jones; Sgt. R. R. Jones; Flt. Sgt. S. Jones; Sgt. T. M. Jones; P/O. F. M. Kelleher; F/O. C. Large; Sgt. J. C. Lee; P/O. W. C. Luff; Sgt. A. L. McConnell; Sgt. F. McCrae; Sgt. J. W. McDonald; Sgt. W. G. Mann; Sgt. M. A. Martin; Sgt. R. Martin; F/O. R. W. Morrison; P/O. D. R. Murphy; Sgt. W. V. Murray; Sgt. D. Naylor; Sgt. H. H. Newburn; Sgt. H. Owen; Sgt. G. R. Parker; Sgt. D. W. Price; Sgt. R. F. Purkiss; Flt. Sgt. J. Quinn; Sgt. R. G. Sharp; Sgt. K. Singleton; Flt. Sgt. N. T. Steele; F/O. R. H. Taylor; Sgt. G. R. Tomlinson; Sgt. T. S. Trinder; Sgt. E. B. Upton; Flt. Sgt. A. B. Walker; Sgt. M. F. R. Walters; Flt. Sgt. S. J. Wareham; P/O. W. P. White; Sgt. A. Wiggins; Sgt. W. V. Wilkes; Sgt. T. S. Wilkinson; Sgt. R. Williams; Sgt. R. W. Wilmott; Sgt. R. J. Winfindale; Sgt. G. D. Wright; Sgt. H. J. Wright; Sgt. R. C. Yates.

KILLED ON ACTIVE SERVICE.—Sgt. I. M. Adams; Sgt. G. V Bourne; F/O. A. K. Brook; Sgt. D. M. Cracknell; Sgt. V. R. Cundiff; F/O. J. F. Cusworth; Sgt. T. T. Davison; Sgt. H. R. Freeman; Sgt. A. E. Jennings; Sgt. J. E. G. Nowlan; A/C.1 R. H. W. Overman; Sgt. R. J. Payne; Sgt. W. L. Pemberton; Sgt. A. H. Robertson; Sgt. L. N. Singer; Sgt. I. L. Wilkinson; Sgt. H. L. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. S. Sabin.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Cpl. R. Atkinson; Sgt. F. R. Bradbury; P/O. D. C. Stone.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. E. T. Bennett.

DIED ON ACTIVE SERVICE.—L.A/C. W. A. Avery; L.A/C. R. J. Bennett; L.A/C. H. Cooper; A/C.2 R. V. Desborough; A/C.1 S. J. Marks; L.A/C. T. S. W. Murdie; A/C.1 T. H. Orrell; L.A/C. A. E. Pilcher; A/C.2 K. W. Pringle; L.A/C. J. B. Thompson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt E. R. Burbage; Flt. Sgt. R. Evans.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 L. Griffiths

No. 101 Squadron R.A.F. "Mens Agitat Molem" (Mind over Matter).

No. 149 Squadron R.A.F. "Fortis Nocte" (Strong by Night).

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. R. Feakes; Flt. Sgt. W. A. Gunning.

MISSING.—Flt. Sgt. D. S. Alexander; Flt. Sgt. D. G. Barrett; Flt. Sgt. D .W. Batten; Act. Flt. Lt. W. N. Belford; Flt. Sgt. F. S. Carran; F/O. F. S. G. Chidgey; F/O. D. C. Dunn; Flt. Sgt. E. F. G. Gloster; Flt. Sgt. R. Gould; Flt. Sgt. D. J. Cowin; P/O. K. H. W. Kirkland; F/O. A. J. D. Leslie; Flt. Sgt. W. R. McLachlan; P/O. J. A. McLoughlin; Act. Flt. Lt. F. W. Mack; Flt. Sgt. B. K. Maunsell; Flt. Sgt. A. Morgan; Flt. Sgt. O. H. M. Shepherd; Act. Sqn. Ldr. L. J. Simpson, D.F.C.; W/O. J. Stanley; Flt. Sgt. L. J. Thyer; Flt. Sgt. C. E. Trebilcock.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. W. H. A. Daly; Flt. Sgt. L. M. Setgeant; P/O. N. G. Wilson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. P. S. Kennedy; Flt. Sgt. B. R Lambert; Flt. Sgt. A. F. Liebich.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. R. L. Sanderson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED WOUNDED OR INJURED IN ACTION.—W/O. J. L. McAninch.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Flt. Sgt J. C. Graham.

MISSING.—Flt. Sgt. T. J. Griffin; P/O. W. Gunn; Flt. Sgt. L. S. Hammett; Flt. Sgt. S. M. Liddle; W/O. J. Sirovyak; F/O. G. S. Walker; W/O. R. F. Woods.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. E. Fairhead; Flt. Sgt. J. B. Fox; F/O. J. E. Nevins; F/O. R. A. J. Vass.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. J. P. Gillis; Sgt. R. E. Iggulden.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. T. Chliszczyk.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. R. W. Lornie.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. M. P. Riordan.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Flt. Sgt. H. I. Herbert.

MISSING.—Flt. Lt. M. R. Breed; P/O. C. F. Farquharson; Act. Flt. Lt. H. G. Hicks; F/O. R. E. Leigh; Flt. Sgt. N. J. McCook; Flt. Sgt. L. R. Taylor; Flt. Sgt. A. W. Todd.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. L. Timlin.

South African Air Force

MISSING, BELIEVED KILLED IN ACTION.—Capt. J. A. Meiring.

MISSING.—Flt. Sgt. J. Anderson; Lt. A. Earl; Flt. Sgt. G. V. Hare; Lt. J. R. Harmer; Lt. H. A. Schonken; Capt. A. C. Warner.

Official Corrections

Casualty Communiqué No. 366.

Under "KILLED IN ACTION" delete F/O. R. H. Edmeades.

R.A.F., under "KILLED IN ACTION" for P/O. J. R. Markey read F/O. J. R. Markey.

R.C.A.F., under "MISSING" delete Flt. Sgt. R. J. Irvine